SCIENCE ABSTRACTS.

Section A.—PHYSICS.

JULY, 1932.

GENERAL PHYSICS.

2216. Lagrange's Compound Pendulum. H. Bateman. *Am. Math. Monthly,* 38. [8 *pp.*] *Jan.,* 1931.—A mathematical analysis based on Lagrange's solution of dynamical problems using Laguerre's polynomials. The oscillations of a vertical chain are considered by representing it as a set of similar weights equally spaced on a light string. The case of an unlimited string is considered. The analogy to the wave-equation and that of heat conduction is shown. The theory of the torsional vibrations of a loaded shaft follows quite simply. H. M. B.

2217. Apparatus for the Measurement of Time Unaffected by Acceleration of the Support. P. le Rolland. *Comptes Rendus,* 194. *pp.* 47–49, *Jan.* 4, 1932.—The motion of apparatus comprising two pendulums suspended from the same support is discussed mathematically, and an experimental verification of the mathematical principle involved is briefly indicated. J. S. G. T.

2218. Isochronism of a Pendulum Maintained in Oscillation by an Impulse Acting after the Pendulum has passed through the Vertical. C. Féry and N. Stoyko. *Comptes Rendus,* 194. *pp.* 689–691, *Feb.* 22, 1932.—The degree of isochronism of a pendulum, as conditioned by the arc of swing, can be improved over that of a free pendulum by impulses applied after the pendulum has passed through the vertical position. This has been verified experimentally; here the matter is investigated theoretically. Satisfactory agreement is found between experimental and theoretical results. J. S. G. T.

2219. Simplified Method for Calculating Periodicities. S. R. Savur. *Indian Journ. Phys.* 6. *pp.* 527–541, *Feb.* 29, 1932.—A simplified method of periodogram analysis is described for finding the principal periods when a set of data varying with time is given. It is shown how tests are applied to find if any other periods besides those first obtained have significance and also how the true amplitude and phase of the principal periods may be estimated. An example is worked out for the magnitudes of a variable star given by Whittaker and Robinson. The results are satisfactory and the method is less laborious than previous ones. H. M. B.

2220. Simple Harmonic Continuous Calculating Machine. J. M. Robertson. *Phil. Mag.* 13. *pp.* 413–419, *Feb.,* 1932. *Supplement.*—A mechanical method is described for summing single, double and triple

Fourier series, and solving sets of linear and certain transcendental simultaneous equations. In principle it amounts to a generalisation of Kelvin's tide-predicting machine and his equation-solving machine, with an extension to several dimensions. A simple model consisting of two components has been made, and is used to illustrate the method of working. AUTHOR.

2221. Numerical Integration by an Interpolation Method. G. Schulz. *Zeits. f. angew. Math. u. Mechanik,* **12.** *pp.* 44–59, *Feb.*, 1932.—A method is analysed in full for the numerical integration of first order differential equations of the form $\frac{dy}{dx} = f(x, y)$. A continuous extrapolation method for this equation was originally given by J. C. Adams (1883). In this paper a system of continuous interpolation is developed, and results in a more accurate integration. J. P. A.

2222. Reade's Iriscope and the Wetting of Solid and Liquid Surfaces by Water. M. Guillot. *Comptes Rendus,* 194. *pp.* 166–169, *Jan.* 11, 1932.—Phenomena similar to those exhibited by the iriscope may be observed at certain solid surfaces without the interposition of a film of soap or similar substance. With a perfectly clean glass surface, for instance, the moisture film is continuous and its optical thickness varies continuously from point to point. The surface should not be polished or cleaned with, *e.g.*, chromic acid, as the film then tends to be discontinuous; perfect wetting is obtained only with a surface produced by fracture or fusion, or by cleaning with HF. Similar perfect wetting is exhibited by the surfaces obtained by fracture along a plane of cleavage of inorganic crystals such as mica, alum and many salts, and of organic substances such as saccharose, citric acid, gum arabic, etc.; negative results are obtained with metals, pyrites, etc., and with certain organic compounds such as thymol, copal and colophony. With soluble substances the iridescent effect is transient. Films are obtained with water on cedar, linseed, olive and arachis oils, and these substances are therefore completely wetted by water, in contradiction to the views of Devaux. H. F. G.

2223. Capillary Activity in Aqueous Solutions. H. Mills. *Chem. Soc., J. pp.* 419–430, *Feb.*, 1932.—It is noticed that when a solute is of limited solubility, there are inflexions in the surface tension—concentration $(\gamma - c)$ curves. This is because adsorption causes the growth of a layer of solvent more concentrated than the bulk of the solution. An explanation is given for the fact that the actual experimental amount of solute adsorbed at the surface is frequently much greater than that indicated by Gibbs' equation. A method of determining the rate of adsorption shows that in the case of nonoic acid the rate is proportional to the square of the bulk concentration. H. M. B.

2224. Spinometer and its Uses. Parts I and II. S. Iwasaki. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers Nos.* 351–352. *pp.* 37–50, *Feb.*, 1932. *In German.*—The author seeks to find a means for the direct measurement of the spinning power of cellulose solution, *e.g.*, viscose, etc., as used in artificial silk and rayon production. He defines the spinning power λ by means of a ratio $\lambda = V/v$, where V is the peripheral speed of a bobbin upon which the filament is wound when rupture just does not occur, *i.e.*, the limiting speed to avoid breakage, and v is the velocity of efflux of the cellulose filament from the solution in the spinning bath.

Both these velocities are expressed in metres per minute, and the author postulates that each centimetre of the coagulum thus withdrawn from the spinning bath will correspond to λ cm. on the winding bobbin. With vertical spinning and withdrawal the quantity $(\lambda - 1)$ gives the maximum extensibility and the quantity λ also expresses the plasticity. The apparatus is simply a differentially geared wheel system by which the rate of efflux from the solution and the rate of winding on to a bobbin can be regulated so as to create a drawing or drafting action. The author claims to be able to investigate the relationship of λ to various constitutional factors and experimental conditions such as, *e.g.*, temperature, viscosity, composition of the solution, extensibility and characteristics of the filament so spun, etc. Part II is devoted to the study of these various factors as affecting viscose. Tables are appended showing the results obtained for the relationship between the maturity of the viscose bath, the composition and the period of working of the spinning bath with the spinning power of the filament. The relationship between the characteristics of the resulting rayon and the elasticity ratio for each set of conditions is also recorded. S. G. B.

2225. Viscous Friction. P. E. Mercier. *J. de Physique et le Radium*, 3. *pp*. 73–82, *Feb.*, 1932.—By the use of orthogonal curvilinear coordinates simpler expressions are deduced for the viscous stresses tangential and normal to the direction of motion in a viscous fluid; it is then shown that μ, the viscous friction, increases in the boundary layer. The results are deemed applicable to problems in hydraulics. [See Abstract 2907 (1931).] C. A. S.

2226. Resistance to the Motion of Bodies in a Powdered Medium. N. Moisseiev. *Accad. Lincei, Atti*, 15. *pp*. 135–139, *Jan*. 17, 1932.—The problem dealt with may be considered from two different points of view: as the problem of resistance by a fluid compressible or not to the motion in its midst, or as the problem of resistance to the motion of a medium composed of discrete points, of molecules, the reciprocal action of which has importance and is taken into consideration solely to define the structure of the medium as a whole, whilst in their interrelation with the body which undergoes resistance to its motion the said particles react upon it quite independently. The second problem possesses considerable interest for cosmogony having to do with very rarefied media. It is the second aspect of the problem which is dealt with in the present paper, and general expressions for the resistance are worked out. J. J. S.

2227. Free Vibrations of the Ends of Elastic Tubes through which a Uniform Current of Fluid Flows. F. J. Bourrières. *Comptes Rendus*, 194. *pp*. 49–51, *Jan*. 4, 1932.—The laws are briefly discussed governing the periodic motion of the end of a tube through which a stream of fluid flows. J. S. G. T.

2228. Banded Eddies. H. Journaud. *Comptes Rendus*, 194. *pp*. 52–53, *Jan*. 4, 1932.—Refers to the occurrence of a banded structure in the eddies produced when a thin layer of molten spermaceti or paraffin placed on an inclined plane is heated from below. Quantitative measurements of the spacing of the bands confirm results obtained by Terada and are not in agreement with Rayleigh's theory, which refers to two-dimensional motion only. J. S. G. T.

2229. Vertical Distribution of Velocities over a Weir in the Region of Parallel Flow. M. Golaz and J. Mesnager. *Comptes Rendus*, 194. *pp*. 54–56, *Jan*. 4, 1932.—The authors derive an expression for the velocity distribution in a stream of fluid passing a weir, the velocities at the points in question being along parallel arcs of eccentric circles. [See Abstract 14 (1932).] J. S. G. T.

2230. Elliptical Cavitations. H. Poncin. *Comptes Rendus*, 194. *pp*. 247–249, *Jan*. 18, 1932.—The motion of fluid about an elliptical cavitation is discussed mathematically. The analysis shows that the continued existence of such a cavitation in a perfect fluid in irrotational acyclic motion is possible only when the eccentricity of the ellipse is less than a certain value. The circular cavitation is treated as a special case. [See also Abstract 2914 (1931).] J. S. G. T.

2231. Propagation of Water-Shock across a Node in a Network of Pipes. E. Volterra. *Comptes Rendus*, 194. *pp*. 524–527, *Feb*. 8, 1932. —The case is considered of a network of *n* pipes having a common node. A tap is fixed at the far end of one pipe, while reservoirs at constant level exist at the far end of the others. General expressions are obtained, when the tap is opened, for pressure and speed in terms of two functions. The equation for the node leads to *n* relations by which these functions can be expressed in terms of one another. The case of two pipes is taken first in which a wave arriving at the node is reflected back along the first pipe and propagated in the second. Using graphical methods, as an extension of Conti's method for one pipe, gives the solution. The method can be extended to the case of many pipes. The effect of variation of the section of the pipe at the tap with time is also given. [See Abstract 1759 (1931).] R. S. R.

2232. Ship Waves: Calculation of Wave Profiles. T. H. Havelock. *Roy. Soc., Proc*. 135. *pp*. 1–13, *Feb*. 1, 1932.—The surface elevation of waves produced at the sides of a model vessel moving in water at various speeds is calculated. The theory is developed from the velocity potential of a doublet at any given depth below the free surface of the water. A uniform distribution of doublets on a vertical line is first discussed, and then a similar distribution of finite length in the direction of motion; graphs are given of the surface elevation along the line of motion. A similar analysis is given for the distribution corresponding to the model vessel used by Wigley in his experiments (*Trans. N.E. Coast Inst. Engineers and Shipbuilders*, 1931, vol. 47, p. 153), having a uniform horizontal section and being sufficiently deep to be treated theoretically as of infinite draught, while the section consisted of a triangular bow and stern connected by a straight middle body. Satisfactory agreement is found between calculated and experimental results. J. S. G. T.

2233. Laminar and Turbulent Flow about Ship Models. W. P. Roop. *Frank. Inst., J*. 213. *pp*. 195–211, *Feb*., 1932.—The total fluid resistance of a ship (or model) is usually separated into viscous and dynamic components which are dependent on values of the former calculated on the assumption that the dynamic resistance obtaining in the experiments is zero. Nevertheless, the usual speeds and lengths of models cause the conditions of flow to approach the range of transition from laminar to turbulent, in which the tangential resistances are of very different values; further, the dynamic resistance is somewhat obscurely related to the form and speed of the model, and its analysis rests largely on an empirical basis. Instead, therefore, of throwing the whole uncertainty on the dynamic factor, a more flexible assumption is suggested for the viscous resistance together with certain restrictive assumptions as to the dynamic resistance: a fixed expression is adopted for the specific viscous resistance in each régime, flexibility being obtained by choosing an appropriate transition parameter, whilst the dynamic resistance is calculated from an empirical equation by use of average values of the constants derived experimentally. From these quantities the total resistance may be calculated. The results obtained are compared with the values observed with models ranging in length from 2 ft. to 40 ft. H. F. G.

2234. Congruence of Lines of Pressure. E. G. Barrillon. *Comptes Rendus*, **194.** *pp.* **536–538,** *Feb.* **8, 1932.**—The author considers the case of a volume limited by a variable plane and a fixed surface. For the case of a moving plane cutting off at a water surface a variable volume V, and the centre of gravity of the volume being at a variable distance h from the plane of the section, it is shown mathematically that the congruence of the lines of pressure is a congruence of normals. R. S. R.

2235. Theory of Wave Resistance and its Practical Applications. G. Weinblum. *V.D.I.* **76.** *pp.* **127–131,** *Feb.* **6, 1932.**—It is shown that under many conditions it is permissible to employ the theory of ideal liquids to calculate the wave resistance of floating vessels. The practical application of the equations obtained is, however, frequently dependent on somewhat hazardous extrapolations, of which the validity must be ascertained by experimental tests. Although absolute agreement between the theory and the results of such tests is obtained only under restricted conditions, moderate agreement is generally observed, provided that forces due to viscosity do not predominate; even in this case the theory provides a useful working hypothesis. H. F. G.

2236. Dynamics of the Freely-Supported Rectangular Plate. H. Schmidt. *Zeits. f. Physik*, **74. 1–2.** *pp.* **130–139,** *Jan.* **22, 1932.**—Extending previous work on the depression of a rectangular elastic plate subjected over a smaller rectangular area to a uniform pressure [see Abstract 2152 (1931)], the effect of a sudden application of such a load is investigated. From the result a continuous variation of load is considered as in the limit equivalent to a series of such impulses. The example afforded by uniformly accelerated motion of the load rectangle across the plate is worked out. J. P. A.

2237. Flow in a Symmetrical Jet of Gradually Varying Section. H. Reissner. *Zeits. f. angew. Math. u. Mechanik*, **12.** *pp.* **25–35,** *Feb.*, **1932.**—From particular integrals of the general hydrodynamic equations other solutions are obtained which tend asymptotically to the solution for a cylinder. Corresponding to these solutions are free cylindrical surfaces whose sections vary slightly from point to point. General methods for dealing with jets having such surfaces are given. When the shape of the free surface is assigned it is possible to analyse the motion of the fluid fully in several instances. Cases are worked out for a cylinder whose specific contraction σ is given by $\sigma = \sigma_\infty(1-e^{-kx})$, where σ_∞ is the specific contraction at infinity, x is the axial distance and k a constant factor. Both stream line and turbulent motion are considered. J. P. A.

2238. Spin in Aeroplanes. G. A. Crocco. *Accad. Lincei, Atti,* 15. *pp.* 5–11, *Jan.* 3, 1932.—A mathematical discussion of the conditions under which an aeroplane can take up a spin during flight and of the conditions tending to prevent this. J. W. T. W.

2239. Flow of Gases under Low Pressures. H. Ebert. *Phys. Zeits.* 33. *pp.* 145–151, *Feb.* 15, 1932.—A critical review of the literature and experimental work, more especially by Knudsen, Gaede, Prandtl and v. Smolukowski, relating to the flow of gases in circular channels under conditions such that the motion may be (1) stream line, or (2) determined by the molecular mean free path or (3) a mixture of (1) and (2). J. S. G. T.

2240. High-Vacuum Distillation Technique. K. Hickman. *Frank. Inst., J.* 213. *pp.* 119–154, *Feb.,* 1932. *Comm. No.* 489 *from the Kodak Research Lab.*—After pointing out the very high concentration of molecules in even the best vacua, and showing in a diagram the limits attainable by various means as compared with the vacua found in nature (in interstellar space, and in the tails of comets, etc.), the general subject of vacuum distillation in chemistry is taken up. Apparatus is described for distillation, and low pressure distillation, with a very useful theoretical treatment. Attention is then turned to apparatus for fractionation. The next section deals with gauges, including the McLeod, Pirani and ionisation gauges, as well as developments of the U-tube manometer, and the article closes with a description of a condensation pump and of drying trains. J. H. A.

2241. Sources of Error in Pressure Measurements with Liquid-Air Traps. M. Rusch and O. Bunge. *Zeits. f. techn. Physik,* 13. 2. *pp.* 77–81, 1932.—Two identical liquid-air traps are put into a circuit and by the use of two Pirani manometers, the difference in pressure on either side of the traps is measured under various conditions, when the apparatus contains air or helium. Graphs are drawn of the difference of pressure on either side of a cooled liquid air-trap with the logarithm of the mean pressure for two types of trap, having different dimensions. A theoretical value is obtained by which the dimensions of the trap may be chosen to make the pressure measurements free from error for the particular conditions. H. M. B.

2242. Stability of Elastic Equilibrium. D. Bonvicini. *Accad. Sci. Torino, Atti,* 66. 6–8. *pp.* 186–194, 1930–1931.—Clears up in a precise manner the theorem of univocity of the statics of elastic solids, having regard to the possibility that the equilibrium may be unstable. Remarks an error in Bryan's fundamental paper, and explains why the application of the energy criterion had nevertheless given in the more common cases correct results. A. D.

2243. Impulses in Elastic Isotropic Bodies. F. Conforto. *Accad. Lincei, Atti,* 15. *pp.* 130–135, *Jan.* 17, 1932.—The method of calculation which is fully successful when applied to the case of the equations of the dynamics of systems of material points does not give satisfactory results when applied to the integration of the equations of the dynamics of elastic isotropic bodies. The author has therefore obtained the equations which determine the discontinuity of the velocity which occurs upon the operation of the impulsive actions by an independent way depending on general principles that correspond in the case of impulsive actions to the cardinal equations of dynamics. J. J. S.

2244. Properties of the Medium in Elastostatics. A. Signorini. *Accad. Lincei, Atti,* 15. *pp.* 151–156, *Jan.* 17, 1932.—Writes the usual Cauchy equations in a form which allows the properties of the material to be taken into account. Applies them to the cases of astatic solicitation, uniform pressure or traction, parallel forces, a solid fixed without friction to a point, and a system in uniform rotation about one of its central axes of inertia. E. E. F. d'A.

2245. Optical Determination of Internal Tensions. H. Favre. *Rev. d'Optique,* 11. *pp.* 1–21, *Jan.,* 1932.—Five photoelastic methods —1 optico-mechanical (Mesnager), 2 optico-graphical (Filon and Coker) and 2 optical (Favre and Fabry)—are compared, and the equations given relating the tensions to the quantities measured. The first three are easily adjusted and comparatively simple but less accurate, the two last are very accurate but require delicate adjustment; a combination of one of the first three and one of the two last is suggested. A detailed account follows of the author's apparatus, giving results accurate within 1 % [see Abstract 20 (1930)]. The possibility is discussed of extending the method to three dimensions by embedding the substance under examination in Pockels glass, which is isotropic under all circumstances. [See Abstract 3325 (1930).] C. A. S.

2246. Deflection of Beams and Struts. H. H. Jeffcott. *Phil. Mag.* 13. *pp.* 310–322, *Feb.,* 1932.—In problems on the flexure of beams it is usual to write $\frac{d^2y}{dx^2}$ for the curvature. This approximation is here taken to a higher order, thus affording results which agree with the more accurate method employing elliptic integrals, and which are markedly different from those of the simple theory. As examples, a vertical rod bent by a load at its upper free end and a cantilever loaded at its free end are considered in detail. J. P. A.

2247. Lines and Diagrams of Influence. E. Müller. *Zeits. f. angew. Math. u. Mechanik,* 12. *pp.* 36–43, *Feb.,* 1932.—The theory of bending of beams is worked out from the standpoint of "lines of influence." When a unit load travelling over the surface of a rod reaches a distance a from a fixed line, a quantity Φ takes the value η. Then $\eta = f(a)$ is the equation of the line of influence for a unit load. Equations of such lines are worked out for unit moment, unit change of curvature and other similar cases. Examples, illustrated by diagrams, are then worked out for the cases of (1) bending of a freely supported straight beam with non-uniform cross-section, (2) horizontal shear in a semicircular beam of uniform section, fixed at both ends. Applications to curved rods and three-dimensional problems are discussed. J. P. A.

2248. Maximum Stresses in a Plane Body containing a Circular Aperture. E. Callendreau. *Comptes Rendus,* 194. *pp.* 435–436, *Feb.* 1, 1932.—On the basis of the formulæ of M. Davin [see following Abstract], the positions at which maximum stresses occur near a circular hole in a plane body are found for the case of a tension in a given direction. If N_r, N_T are stresses parallel and perpendicular respectively to the radius vector from the centre of the hole as origin, and the initial line of polar coordinates r, ϕ, is parallel to the tension, N_T, $N_r + N_T$ have maxima when $\phi = \pm \frac{\pi}{2}$. J. P. A.

2249. Elastic and Plastic State of a Two-Dimensional Body containing an Aperture. M. Davin. *Comptes Rendus*, 194. *pp.* 522–524, *Feb.* 8, 1932.—Continuing a previous mathematical investigation [see Abstract 1489 (1932)] a first approximation is now obtained for the elastic state of a two-dimensional body containing a circular aperture, and subject at infinity to a uniform tension, when the elastic limit is surpassed by an infinitesimal amount. [See preceding Abstract.] J. P. A.

2250. Variable Forces applied to Thin Rectangular Plates. Sonier. *Comptes Rendus*, 194. *pp.* 436–439, *Feb.* 1, 1932.—The depression at any point of a thin rectangular plate subjected to a system of forces is expressed as the sum of a series $\omega = \sum_{m}\sum_{n} A_{mn} \sin\frac{m\pi x}{a} . \sin\frac{m\pi y}{b}$, where m and n are integers. Regarding A_{mn} as functions of the time, the differential equation for thin plates is solved in general terms, and the special case of a load concentrated at a point x_1 is considered, when $x_1 = vt$. Application to the problem of the depression of bridge structures is mentioned. J. P. A.

2251. Circular Cylinders Subjected to Torsion. E. Callandreau. *Comptes Rendus*, 194. *pp.* 687–689, *Feb.* 22, 1932.—The author establishes in a simple manner that the circular cylinder, whether solid or hollow and of constant thickness, is the only form of prismatic body which, when subjected to torque about its axis, is strained so that plane transverse sections remain plane. J. S. G. T.

2252. Plasticity of Steel. K. Hohenemser and W. Prager. *Zeits. f. angew. Math. u. Mechanik*, 12. *pp.* 1–14, *Feb.*, 1932.—A summary is made of the mechanics of plastic materials, and the plasticity conditions of R. v. Mises (*Göttinger Nachr. Math. Phys.* 1. 1913. p. 582) and of Prandtl and Reuss (*Zeits. f. angew. Math. u. Mechanik*, 10. p. 267, 1930) are outlined with special reference to steel. As a test, experiments are performed on thin-walled tubes of steel which are subjected to simultaneous torsion and extension. Neither condition is completely satisfied, although that of v. Mises is the better approximation. A new plasticity condition is formulated, which contains the former two as special cases. Some results of the experiments suggest that no condition which assumes isotropy in the steel will be sufficient. J. P. A.

2253. Flow Potential or Slip-Planes. A. Reuss. *Zeits. f. angew. Math. u. Mechanik*, 12. *pp.* 15–24, *Feb.*, 1932.—The flow-potential theory of v. Mises [see Abstract 2910 (1928)] is generalised so as to account for elastic as well as plastic deformations in a material. A comparison is then made between the general results obtained from (*a*) this theory alone, (*b*) v. Mises' general theory, but employing the plasticity condition of Mohr, based on the slip-plane view of plasticity, and (*c*) the slip-plane theory alone. The case of a tube subjected to torsion is discussed from all three points of view, and formulæ provided for the change of capacity as deduced from each. It should be possible to distinguish between the theories by means of an experimental test of the formulæ. J. P. A.

2254. Newtonian Lines of Force Symmetrical about an Axis. C. Somigliana. *Accad. Sci. Torino, Atti*, 66. 6–8. *pp.* 139–149, 1930–1931. —The determination of the lines of force of a Newtonian field symmetrical about an axis is always possible by means of quadrature, provided the potential function of the field is known. The problem is easily solved if, as is always possible, the potential function is assumed to be expressed as a series of spherical functions of Legendre. E. E. F. d'A.

2255. Newtonian Potential. N. Gunther. *Comptes Rendus*, 194. *pp*. 446–449, *Feb*. 1, 1932.—An expression is obtained for the change of Newtonian potential in a space, and it is expressed as an additive term, this term being a harmonic function. The result is a confirmation of the principal result obtained by Riesz in a paper on sub-harmonic functions and their relation to the theory of potential. R. S. R.

2256. Bertrand's Problem in Mechanics. F. Odone. *Accad. Sci. Torino, Atti*, 66. 6–8. *pp*. 170–183, 1930–1931.—Bertrand's problem (*Liouville's Journ. Math.* 1852, p. 121) is: Given an integral of a problem in mechanics, to find an expression for the forces which produce the motion under the hypothesis that the components of the forces are expressible in functions of only the coordinates of the points of the system. The author attacks some particular cases of this problem. A. D.

2257. Fall Towards Rotating Earth. U. Cassina. *Accad. Sci. Torino, Atti*, 66. 14–15. *pp*. 428–432, 1930–1931.—A body freely falling without initial velocity deviates from the vertical towards the east. This is old, but the author shows how to obtain the usual results by vectorial methods without any integration. A. D.

2258. Motion of a Heavy Body relative to a Fixed Point. M. Manarini. *Accad. Lincei, Atti*, 14. *pp*. 572–577, *Dec*. 20, 1931.—It is known that where a heavy body is suspended on a fixed point O, there is an infinity of straight lines through O, forming a quadric cone (Staude's cone), which are for the body axes of permanent uniform rotation, each with a corresponding angular velocity. In 1923 van der Woude showed that this cone is formed of straight lines through O which are principal axis of inertia with respect to one of their points. The author shows how to deduce these propositions, and to extend them, finding for the duration of a permanent rotation a formula identical with that of Galileo for the simple pendulum; and he adds some theorems on the geometry of masses. A. D.

2259. Regular Arrangement of Very Small Metal Spheres. F. Stöber. *Kolloid Zeits*. 58. *pp*. 14–17, *Jan*., 1932.—Metal globules 0·005–0·05 mm. in diameter, deposited from a melt, exhibit a regular arrangement which seems to indicate that they are subject to Newton's laws of gravitation. T.H. P.

2260. Mass and Energy. W. F. G. Swann. *Frank. Inst., J*. 213. *pp*. 63–74, *Jan*., 1932.—Questions the validity and the derivation of the expression Mass = Energy/c^2. Works it out, and finds that on classical lines there is an expression $M = (W/c^2)/(1 - 4\beta^2)$, where M is the mass and W is the work performed in constructing the entity from an initial condition in which the elements of the entity are all at infinity. A. D.

2261. Stabilising Effect of Imposed Oscillations on a Dynamical System. E. R. Lowenstern. *Phil. Mag*. 13. *pp*. 458–486, *Feb*., 1932. *Supplement*.—A mathematical paper in which the equations of motion are found for a general Lagrangean system which receives rapid oscillations. From these, the equations of motion and conditions of stability are found for four special cases, one of which is an inverted simple pendulum with two degrees of freedom which receives rapid vertical oscillations at the point of support. The method adopted differs from those previously used, in that the forced vibrations are taken to be of high frequency and small amplitude from the beginning, and modifications consequent on this assumption are made in the general Lagrangean equations of motion.

H. M. B.

2262. Applications of the Ellipsoid of Inertia. D. Wolkowitsch. *Comptes Rendus*, 194. *pp*. 534–536, *Feb*. 8, 1932.—The Culmann central ellipsoid of inertia, its conjugate ellipsoid, and two homocentric and homothetic ellipsoids with ratios of homothety of $1/\sqrt{3}$ and $\sqrt{3}$ are taken, and various relations of a family of tetrahedra with them are discussed. The applications of these relations to dynamics and the motion of a solid around a fixed axis and a fixed point are examined. R. S. R.

2263. Motion of n-Bodies. M. Mendes. *Comptes Rendus*, 194. *pp*. 597–599, *Feb*. 15, 1932.—Given a solution of the equations of motion for n bodies of constant mass attracting one another according to the inverse square law, it is shown how a solution for variable masses can be derived. G. C. McV.

2264. Collisions in the Problem of Three Bodies. D. Belorizky. *Comptes Rendus*, 194. *pp*. 769–771, *Feb*. 29, 1932.—Two of the bodies describe circular orbits whilst the third body, which is small, is supposed to collide with one of the other two. The orbit of the small body near the point where the collision occurs is calculated. G. C. McV.

2265. Influence of Temperature upon the Parameter of Calcite. E. Fukusima. *Hiroshima Univ., Journ. Sci*. 1. *pp*. 195–201, *Oct*., 1931. *In German*.—Description of an apparatus for Laue photographs at high temperatures and its application to X-ray constants for calcite. For the change $U_t - U_t'$, for $t = 16°$ and $t' = 300°$, the value 0·0212 results.

F. I. G. R.

2266. Orientation of Zinc Crystals Deposited on Iron Plates. Y. Matsunaga. *Kyoto Coll. Sci., Mem*. 14. *pp*. 263–265, *Nov*., 1931. *In English*.—It is found by X-ray diffraction that the zinc crystal deposited on the surface of iron plate consists of a single crystal of zinc, and that the basal plane (0001) of the hexagonal closed-packed zinc crystal is inclined to the surface of the iron plate at an angle of about 18°. AUTHOR.

2267. Orientation of Crystals Deposited in Contact with a Mica or Chlorite Cleavage. L. Royer. *Comptes Rendus*, 194. *pp*. 620–621, *Feb*. 15, 1932.—Crystals deposited from solutions of a large number of inorganic salts on a fresh cleavage surface of mica or chlorite are found to be orientated by such surface. T. H. P.

2268. X-Ray Examination of Modifications of Phosphorus Pentoxide. K. Boratynski and A. Nowakowski. *Comptes Rendus*, 194. *pp*. 89–91, *Jan*. 4, 1932.—50 gm. of phosphorus pentoxide, "for analysis," (*a*), when sublimed at 300° in oxygen yielded 25 gm. of brilliant crystals (*b*), density 2·100; there was left an amorphous non-volatile residue (*c*), density 1·80. X-ray examination showed the crystal structure of (*a*) and (*b*) to be similar, rhombohedral, with *a* 11·12, *c* 1·12 Å., the unit cell containing $12P_2O_5$. The amorphous residue (*c*) gave only a few indistinct rings. Ordinary phosphorus pentoxide is accordingly predominantly the crystalline form, but is partly polymerised on heating to the amorphous form. C. A. S.

2269. Crystal Structure of the Chloroplatinates of Cæsium and Rubidium. G. Natta and R. Pirani. *Accad. Lincei, Atti,* 15. *pp.* 92–99, *Jan.* 3, 1932.—Examination by the powder method shows that both cæsium and rubidium chloroplatinates form cubic crystals with four molecules in the unit cell; the sides of the cell are 10·15 ± 0·01 and 9·83 ± 0·01 Å., and the calculated densities 4·25 and 4·04 for the cæsium and rubidium compounds respectively. The crystals of both compounds belong to the spac group O_h^5 and exhibit structure analogous to that of the corresponding potassium compound. For cæsium chloroplatinate the parameter u, which defines the position of the chlorine ions, is calculated to be about 0·23–0·24. T. H. P.

2270. Crystal Structures of Krypton, Xenon, Hydrogen Iodide and Hydrogen Bromide as Functions of Temperature. Barbara Ruhemann and F. Simon. *Zeits. f. phys. Chem.* 15. *Abt.B.* 6. *pp.* 389–413, *Feb.*, 1932.—A special camera is described for investigations at low temperatures, yielding the following results: Kr and Xe are cubic face-centred; no sign of a transformation in the former appears between 82° and 92° Absolute. HI gives a tetragonal face-centred lattice with the axial ratio 1·08, apparently with no transformation; the density indicates a molecular lattice. HBr is probably rhombic face-centred, but the powder method is not capable of giving a complete decision. **Errata,** *ibid.*, 16. 4–5. p. 408, April, 1932. F. I. G. R.

2271. Persistence and Development of Crystal Nuclei above the Melting Temperature. W. T. Richards. *Am. Chem. Soc., J.* 54. *pp.* 479–495, *Feb.*, 1932.—It is suggested that crystal form may persist above the melting temperature if an adsorbent is present for which the heat of binding of the crystalline adsorbate is greater than that of the liquid adsorbate. This hypothesis accounts for the behaviour of undercooled liquids observed by previous investigators. Since the liquid adsorbate is in part undercooled above the melting temperature, a mechanism is found for the enhancement of the ability of a liquid to crystallise by treatment above its crystallisation temperature. It is inferred from experimental evidence that the development of the crystalline adsorbate requires a considerable activation energy. A similar explanation applies to the behaviour of two types of supersaturated solution, and the relation of the hypothesis to the law of stages is discussed. Possible applications of this viewpoint to X-ray diffraction, purification of materials, treatment of glasses and alloys and the thermodynamic theory of adsorption are briefly indicated. H. H. Ho.

2272. Dimorphism of Normal Saturated Aliphatic Dicarboxylic Acids as a Function of the Temperature. F. D. la Tour. *Comptes Rendus,* 194. *pp.* 622–623, *Feb.* 15, 1932.—Further examples of dimorphism [see Abstract 3699 (1931)] are observed with glutaric acid and with the homologous acids $C_{11}H_{20}O_4$, $C_{13}H_{24}O_4$, $C_{15}H_{28}O_4$ and $C_{17}H_{32}O_4$. T. H. P.

2273. Helenin Spherolites with Helicoidal Winding. P. Gaubert. *Comptes Rendus,* 194. *pp.* 733–736, *Feb.* 22, 1932.—Crude helenin, melted on glass under a cover-glass, gives three types of spherolites: (*a*) arranged around the axis of maximum refraction, with helix pitch $< 40\,\mu$, and melting point about 115° (isoalantolactone); (*b*) similarly arranged, but with pitch about 400 μ; and (*c*) arranged around the axis of mean refraction, but otherwise resembling (*a*). (*b*) on heating becomes uniaxial at about 65°, above which temperature the spherolites are arranged around the axis of mean refraction as in alantolactone, while the double refraction steadily decreases. These changes are reversible unless cooling is very slow, when there are indications of a mixture of the two lactones being formed. Impure alantolactone crystallised below 0° shows diffraction rings [see Abstract 3324 (1931)]. These appearances provide a test for the purity of helenin preparations. C. A. S.

2274. Influence of RO_4 and Related Ions on the Habit of Crystals of Potassium Sulphate. H. E. Buckley. *Zeits. f. Krist.* 81. *pp.* 157-168, *Feb.*, 1932. *In English.*—S_2O_3'' causes a great extension of (001), the crystals forming thin plates; S_2O_6'', NO_3' and ClO_3' have a similar but decreasing effect; Cr_2O_7'' enlarges (010) and distorts the other faces; H_2XO_4', HXO_4'' and XO_4''' (X = P, As), ClO_4', MnO_4', CO_3'', BrO_3' and B_2O_7'' have no effect, save in so far as alkali is formed by hydrolysis of salts containing them, which causes development of the minor faces. The probable symmetry of SO_4'' and other RO_4 ions is discussed, and it is concluded that as a rule they are rhombic in type, but that trigonal, tetragonal and other symmetry is possible. C. A. S.

2275. Pure Crystallography of a Discontinuum. H. Heesch. *Zeits. f. Krist.* 81. *pp.* 230–242, *Feb.*, 1932.—The point is to refer the 230 space groups to geometrical point systems only involving the lattice points themselves. Such a domain does not possess the property of continuity as does ordinary space. The elementary cell is enlarged by taking whole multiples N_a, N_b, N_c of the usual parameters *a*, *b*, *c*. There are then $2^{N_aN_bN_c}$ possibilities of either occupying the $N_aN_bN_c$ points of an elementary cell, or of leaving them free. Examples for a few common substances (*e.g.*, Cu and NaCl) follow. F. I. G. R.

2276. Influence of Addition of Foreign Substances on the Limits of Cohesion and Ultramicroscopic Sol Formation of Synthetic Rock-Salt Crystals. Part I. KCl, $CaCl_2$, $BaCl_2$. A. Edner. *Zeits. f. Physik,* 73. 9–10. *pp.* 623–648, *Jan.* 8, 1932.—Investigation of the influence of the conditions of crystallisation on the limits of cohesion and the ultramicroscopic properties renders it possible to prepare pure NaCl crystals (99·99 mol. %) with reproducible properties and with strength comparable with that of the best natural rock-salt crystals. The properties of these crystals are modified by the presence of about 0·02 mol. % of KCl, but similar changes are effected by 0·002 mol. % of calcium or barium chloride. The changes in properties are discussed in detail. T. H. P.

2277. Experiments on Cohesion. Part III. (110) Cleavage in Rock-Salt. H. Tertsch. *Zeits. f. Krist.* 81. *pp.* 264–274, *Feb.*, 1932.—Applying similar methods [see Abstracts 17 and 2919 (1931)] to (110) cleavage slabs the results with repeated small equal blows (*Schlagspaltung*) and with steady pressure (*Druckspaltung*) on completely supported slabs show the same relations to thickness as in the case of (100) slabs, but only about one-third the number of blows was required for rupture, but about five times the pressure. For rupture with a single blow (*Zugspaltung*) of a slab with 5-mm. gap between supports the strength of blow varied as the square (instead of the cube) of the thickness, and was about double that required for a (100) slab. Great difficulty was experienced in getting satisfactory (110) slabs. [See following Abstract.] C. A. S.

2278. Cleavage Process in Crystals. H. Tertsch. *Zeits. f. Krist.* 81. *pp.* 275–284, *Feb.*, 1932.—In view of the fact that there is attraction between unlike and repulsion between like ions in the crystal lattice of rock-salt, calculation shows that (cohesion between adjacent (100) planes):(that between adjacent (110) planes) = 2·586 : 1·828 (approx.). Repeated small equal blows (*Schlagspaltung*) overcome this by causing gradually increasing simple separation between successive planes with no sudden rupture, and is consequently easier between (110) planes than between (100). For tensile strength it is shown that opposite relations hold. Steady pressure (*Druckspaltung*) increasingly distorts the lattice, diminishing the attractive force by increasing the distance between unlike ions, and increasing the repulsive force by decreasing that between like ions, until the latter overcomes the former and sudden rupture occurs. Rupture by a single blow of the partially supported slab (*Zugspaltung*) is probably due to a combination of both processes. [See preceding Abstract.] C. A. S.

2279. Solidity of Moist Salt Crystals. Part III. Orientation and Tensile Strength of Dry and Moist Rock-Salt. G. F. Sperling. *Zeits. f. Physik*, 74. 7–8. *pp.* 476–502, *Feb.* 23, 1932.—The experiments were made with rods split or cut from two blocks of rock-salt. The strengths of the rods split parallel to the cube faces differed in the three different directions so that the crystals are really anisotropic. The elastic limits and the translation mechanism were the same for the dry and moist experiments. Very little rotation of the lattice was observed with dry salt, while with moist salt alterations in angle up to 30° take place. Only quantitative but no qualitative differences have been found between dry and wet rock-salt. These differences are of the same kind as between dry salt at low and at high temperatures. This corresponds to Smekal's view that the great increase in strength of moist salt is to be referred to normal distortion and strengthening phenomena, and can be considered as a volume action of impenetrating solvent material. [For Part II see Rexer, Abstract 1090 (1932).] H. N. A.

2280. Mathematical Theory of Regularity according to Grain-Form for Affine Deformation. A. March. *Zeits. f. Krist.* 81. *pp.* 285–297, *Feb.*, 1932.—The paper sets out to establish a number of geometrical conditions imposed by a system of linear equations of the usual form describing transformations of point systems in an affine field. They are suitable for dealing with assemblages according to grain-form, but no direct application to crystals is made. F. I. G. R.

2281. Kinematics of Passive Assemblage-Regularities. B. Sander. *Zeits. f. Krist.* 81. *pp.* 298–308, *Feb.*, 1932.—A discussion of the conditions obtained by March [see preceding Abstract]. F. I. G. R.

2282. Method of Testing the Laws of Brownian Motion. E. M. Brumberg and S. I. Wawilow. *Zeits. f. Physik*, 73. 11–12. *pp.* 833–843, *Jan.* 15, *and* 75. 11–12. *pp.* 746–747, *May* 6, 1932.—A formula is worked out for the area described in the field of the microscope in a given time by a Brownian particle. This formula is based on two fundamental laws, and presents the advantage that the dimensions of the particles do not appear in it. Experiments were made with rubber emulsion with viscosities varying a thousandfold. The results are best with extremely viscid liquids. A. D.

2283. Isotopic Constitution and Atomic Weights of Cæsium, Strontium, Lithium, Rubidium, Barium, Scandium and Thallium. F. W. Aston. *Roy. Soc., Proc.* 134. *pp.* 571–578, *Jan.* 2, 1932.—Records failures with a volatile chlorine compound of tantalum, and with a volatile platinum compound. Describes improvements in technique, which enable the method of accelerated anode rays to be applied very satisfactorily to the new mass-spectrograph. Experiments with Cs indicate that the atomic weight is 132·917 ± 0·02. This suggests that the value 132·81 now in use is definitely too low. Sr has three isotopes, with mass numbers 86, 87 and 88, the percentage abundances being 10·0, 6·6 and 83·3. Assuming a packing fraction of −8·2, and correcting for change of scale, the atomic weight is 87·64 ± 0·06, in excellent agreement with the chemical value 87·63. Li gave the round figure of 11 as the most probable value for the ratio between the abundances of Li^7 and Li^6. Correcting for packing fraction and change of scale the atomic weight is 6·928 ± 0·008. The latest direct physical measurements are in good agreement with each other. Ba proved to have three new isotopes. The mass numbers of its 4 isotopes are 135, 136, 137 and 138, the percentage abundances are 5·9, 8·9, 11·1 and 74·2; packing fraction of Ba^{138} = −6·1 ± 2, atomic weight 137·43 ± 0·08, chemical value 137·36. Sc gave only one line, and any other isotope present to the extent of 3 % could have been detected. Most probable packing fraction −7, atomic weight 44·96 ± 0·05; the chemical value 45·1 probably needs revision. Tl has two isotopes, mass numbers 205 and 203, abundance ratio 2·40 : 1, packing fraction roughly 1·8 ± 2, atomic weight 204·41 ± 0·03, which agrees excellently with Hönigschmid's value 204·39. H. N. A.

2284. Element 87. F. Allison, Edna R. Bishop, Anna L. Sommer and J. H. Christensen. *Am. Chem. Soc., J.* 54. *pp.* 613–616, *Feb.*, 1932.—Continues the research by Allison and Murphy [see Abstract 807 (1931)] on the new element; the same magneto-optic method was employed. Characteristic minima, as previously announced, have been obtained for the chloride, nitrate, sulphate and hydroxide of a kation whose equivalent weight is greater than that of Tl$^+$. These minima cannot be due to SnCl$_3^+$ or ReCl$^+$; they are attributed to element 87. The characteristic minima are not affected by acids, bases, oxidising or reducing agents. The element appears to have six isotopes; several sources of the element were found, but the concentration in each is very low. The name Virginium and the symbol Va are suggested. [See following Abstract.] H. N. A.

2285. Concentration, Acids and Lithium Salts of Element 85. F. Allison, Edna R. Bishop and Anna L. Sommer. *Am. Chem. Soc., J.* 54. *pp.* 616–620, *Feb.*, 1932.—Allison and Murphy [see Abstract 807 (1931) and preceding Abstract] obtained, by means of the magneto-optic method, evidence of the existence of element 85. A concentrate containing $2\cdot5 \times 10^{-6}$ gm. of the new element alabamine, 85, in the form of lithium alabamide has now been prepared. Minima have been determined for the oxygen halogen compounds. Alabamides are easily oxidised forming hypoalabamites, alabamites, alabamates and peralabamates and their corresponding acids. Peralabamates are the most stable of these compounds. The atomic weight of alabamine is estimated at 221. H. N. A.

2286. Field of Force and Form of the Carbon Dioxide Molecule. T. L. Ibbs and A. C. R. Wakeman. *Roy. Soc., Proc.* **134.** *pp.* 613–642, *Jan.* 2, 1932.—Part I. Thermal diffusion in mixtures containing CO_2.—Measurements are made of k_T, the ratio of the coefficients of thermal and ordinary diffusion in mixtures of H_2 and CO_2, N_2 and CO_2, H_2 and N_2, H_2 and A, up to temperatures of 600° or 700° K. In each of the mixtures containing CO_2, but not in the others, k_T has one value up to about 145° C., and a higher value above that temperature. Although this sudden change has not previously been noted, corroboration is obtained from previous results by other observers. The conclusion may be drawn that at higher temperatures the CO_2 molecule is a closer approach to a rigid elastic sphere. Part II. Variation of viscosity of CO_2 with temperature.—By means of a transpiration method, designed to give good comparative values, the viscosity of CO_2 is measured at different temperatures up to 250° C. A slight but distinct change in the viscosity-temperature relation is revealed at about 140° C. The results indicate that the viscosity varies as a power of the absolute temperature: thus suggesting that the molecules may be considered as point centres obeying an inverse power law. The index of this force is calculated as 5·7 at temperatures below, and 7·8 above 140° C. This result is in general agreement with those derived from other observers. Part III. Form of the CO_2 molecule.—A survey of the evidence for a change in molecular form of the CO_2 molecule at temperatures near 145° C. leads to the conclusion that at low temperatures the C atom probably lies between the two O atoms and in the straight line joining them, whereas at higher temperatures it is probably displaced from this position to form a " bent " molecule. J. P. A.

2287. Radius of Action of Bound Atoms and the Ortho Effect with Dipole Moment. M. Magat. *Zeits. f. phys. Chem.* 16. *Abt.B.* 1. *pp.* 1–18, *Feb.*, 1932.—The conception of steric hindrance is made definite in connection with recent papers by Slater, London and Wohl. The radii of action of bound atoms are estimated, using plausible assumptions, and the possibility of explaining the ortho effect with dipoles by means of steric hindrance is investigated. In conclusion a way of looking at the ortho effect is proposed, which is built up on Hund's views as to the nature of the valence directive forces. H. N. A.

2288. Allotropy of Liquid Benzene. A. W. C. Menzies and D. A. Lacoss. *Nat. Acad. Sci., Proc.* 18. *pp.* 144–147, *Feb.*, 1932.—It is pointed out that the rate of change with temperature of several physical properties of liquid benzene suffers a more or less abrupt alteration at about 40° C. Reference and use are made of the work of S. Young on the rate of change of the specific volume of liquid benzene with temperature, of the work of Parker and Thompson for values of the refractive index of benzene against temperature and on the influence of pressure on the melting point of benzene according to Puschin and Grebenschtschikow. Such physical properties as dielectric constant, specific heat, viscosity and vapour pressure are also considered. J. K.

2289. Theory of Atoms with Many Electrons. J. G. Kirkwood. *Phys. Zeits.* **33.** *pp.* 57–60, *Jan.* 15, 1932.—The polarisation, diamagnetic susceptibility and van der Waals force of atoms with many electrons are studied. The method is an approximate perturbation one, the wave functions for atoms with many electrons not being accurately known. The numerical results are in agreement with experiment. G. C. McV.

2290. Wave Equation of Hydrogen Atom. E. A. Hylleraas. *Zeits. f. Physik*, 74. 3–4. *pp*. 216–224, *Feb*. 11, 1932.—The general commutation law for functions of coordinates and momenta is worked out. The second order wave equation for the hydrogen atom is then obtained and solved in terms of the Legendre polynomials. G. C. McV.

2291. Multiple Excitation of Complex Atoms. L. Goldstein. *Comptes Rendus*, 194. *pp*. 773–776, *Feb*. 29, 1932.—The theory, according to quantum mechanics, of the simultaneous excitation of two electrons of an atom due to a bombardment by a stream of electrons. G. C. McV.

2292. Possible Explanation of the Difference between the Mass of the Proton and the Electron. A. Proca. *J. de Physique et le Radium*, 3. *pp*. 83–101, *Feb*., 1932.—Proposes a "new mechanics" in which—proceeding in the inverse manner to wave mechanics, in which a material point is treated as a wave, the laws of optics being applied to it—a photon is treated as a material point. The mass of an electron or of a proton in repose is considered as being in reality a magnitude which does not depend uniquely on the particle considered. It can be written $A + eB$ for the proton and $A - eB$ for the electron, e being the charge of the particle. A is a coefficient which is characteristic of the particle, and can be spoken of as its true mass; it is the same for the proton and the electron. B is a term which depends on the electromagnetic field which comes into play in all measures of the "mass" such as can actually be carried out, it is a term which is slowly variable, and which depends on the type of experiment considered. These results follow from the introduction into the theory of the electromagnetic field and of radiation of a characteristic new element, which is invariant with respect to the Lorentz group, and which seems to be necessary in all circumstances in order to define the field. It appears that an experimental verification of the basic hypotheses is not impossible. H. N. A.

2293. Quantum Theory of Radiation. E. Fermi. *Rev. Modern Physics*, 4. *pp*. 87–132, *Jan*., 1932.—An account of the present position of the theory of the interaction of matter and radiation. The non-relativistic theory is first dealt with on Dirac's basis: that the radiation field and the atom form one system whose energy is the sum of (*a*) the energy of the atom, (*b*) the energy of the electromagnetic waves constituting the field, (*c*) the coupling energy (supposed small) of the atom and the field. A number of special problems: the Doppler effect, the Compton effect, Lippman fringes, etc., are treated in detail. The author then goes on to the theory of radiation and the relativistic theory of the electron given by Dirac. He shows that scattering from free electrons is not possible, in this case, unless the negative energy states of the electron are allowed. Lastly, a proposed method of quantising any electromagnetic field, not necessarily that of a field of radiation, is discussed. The procedure is to suppose the scalar and vector potentials of the field expressed as Fourier series and thence to derive the quantum Hamiltonian. A serious difficulty is, however, encountered in that the electrostatic energy of point charges turns out to be infinite. No entirely satisfactory alternative theory has been put forward. G. C. McV.

2294. Wave Mechanics of Radiation and Free Particles. E. H. Kennard. *Phys. Rev.* 39. *pp.* 435–454, *Feb.* 1, 1932.—The quantum theory of radiation, formulated in wave-mechanical language, but in terms of running waves, is shown to lead as a first approximation to the classical theory of emission by a particle. Non-relativistic mechanics is used, and limitations of the method are shown in terms of classical theory. The characteristic quantum phenomenon of the Compton effect requires the Compton recoil to exceed the particle's momentum spread, so that the wave-packet's diameter shall greatly exceed the incident radiation wave-length; this is realisable on any scale of magnitude. For quasi-classical motion the reverse is required; further, if the motion is to last for a number of wave-periods, the wave-length must greatly exceed h/mc. The classical packet-motion arises from combinations between quantum-states of the particle-field system; this suggests that the photon is not a fundamental constituent of the field, but only one possible aspect of its action. Whereas for problems on energy or momentum an incident wave-train is usually represented by a single typical quantum state, motional phenomena of classical type need a more complete expression. A. H.

2295. Chemistry and the Quantum Theory of Atomic Constitution. N. Bohr. *Chem. Soc., J. pp.* 349–384, *Feb.*, 1932. *Faraday Lecture.* An attempt is made to show, in a retrospective survey, how the fundamental ideas regarding the constitution of atoms have logically developed, and how it has gradually been recognised that the very stability of atomic structures, which is essential for our analysis of natural phenomena, imposes an unavoidable limitation of the use of space-time pictures in accounting for atomic reactions. H. H. Ho.

2296. Integration of the Equation of First Integrals of Quantum Mechanics. J. L. Destouches. *Comptes Rendus,* 194. *pp.* 589–591, *Feb.* 15, 1932.—Previous work is continued [see Abstract 697 (1932)]. Certain operators X of quantum mechanics must satisfy the operational differential equation $x dX/dt = HX - XH$, where $x = h/2\pi i$ and H is the Hamiltonian of a system The form of all such operators in the general case of non-conservative systems is found in this paper. They are shown to belong to a family all of whose members vary linearly with an arbitrary operator X_0. N. D.

2297. First Integrals of Wave Mechanics. L. de Broglie. *Comptes Rendus,* 194. *pp.* 693–695, *Feb.* 22, 1932.—Characteristics of the wave-mechanics operator, A, which is such that $\partial A/\partial t + (AH - HA)/\nu$, ($\nu = h/2\pi i$) are briefly discussed. J. S. G. T.

2298. New Characteristic of the Dirac Electron. A. Proca. *Comptes Rendus,* 194. *pp.* 691–693, *Feb.* 22, 1932.—The author shows that the Dirac electron possesses, in addition to its Uhlenbeck-Goudsmit magnetic moment and the electric moment associated therewith, an electric moment associated with the Lorentz transformations. [See following Abstract.] J. S. G. T.

2299. Magnitudes Characterising the Dirac Electron. A. Proca. *Comptes Rendus,* 194. *pp.* 836–838, *March* 7, 1932.—Characteristics of the Dirac electron are briefly discussed. These include two invariants, *viz.*, the electric charge and free magnetic charge, an asymmetric tensor of the second order, and two quadri-vectors, *viz.*, the electric and magnetic

currents. The observable mean magnetic charge of a free electron is nil. Frenkel's relationships, though inexact for the actual operators, hold for the mean values of these. It is questionable as to whether the equation $J = 0$ (using Darwin's notation) which has been established for a particle carrying no magnetic charge is applicable to the discussion of the Dirac electron, which possesses a magnetic charge. [See also preceding Abstract.]
J. S. G. T.

2300. Structure of Electron Waves. L. Infeld. *Acad. Polonaise Sci. et Lettres, Bull. No. 3A. pp.* 201–231, *March,* 1931. *In German.*—Dirac's system of wave equations for the free electron is recast first into a form analogous to Maxwell's electromagnetic equations and then in general covariant form. This leads to a study of the structure of the de Broglie electron waves in a metrical field. It appears that the electron waves, corresponding to a stream of electrons moving with uniform velocity, exhibit a group structure in the direction of motion, *i.e.*, the amplitude and hence the electron density varies periodically, and the " wave-length " of this amplitude fluctuation depends upon the average electron density. Taking account of the metrical field also leads to an expected broadening of electron diffraction rings dependent on both the electron velocity and the current density in the diffracted stream. The experimental evidence for broadening of electron diffraction rings dependent on these two factors is reviewed. A difficulty is that some of the broadening dependent on electron velocity may be attributable to the action of the diffracting crystal. W. S. S.

2301. Hamiltonian Systems and Transformations in Hilbert Space. B. O. Koopman. *Nat. Acad. Sci., Proc.* 17. *pp.* 315–318, *May,* 1931.—After a reference to the increasing application of this theory in the most important departments of mathematical physics, the author outlines certain investigations in which the domain of the theory of Hilbert space and its linear transformation has been extended in such a way as to include classical Hamiltonian mechanics, or more generally systems defining a steady n-dimensional flow of a fluid of positive density. The conception of $E(\lambda)$, the spectrum of the dynamical system, is introduced, together with the conception of the spectrum revealing in its structure the mechanical properties of the system. R. S. R.

2302. Proof of Recurrence Theorem for Strongly Transitive Systems and Proof of the Ergodic Theorem. G. D. Birkhoff· *Nat. Acad. Sci., Proc.* 17. *pp.* 650–660, *Dec.,* 1931.—J. v. Neumann, by an application of abstract integral equation theory [see following Abstract] in a direction suggested by Koopman [see preceding Abstract], has obtained results which would show that $t_n(P)/n$ converges in the mean towards τ, but this does not show convergence or a mean time in the usual sense. Hopf has established the results directly. Assuming t_n denotes the time of the nth crossing of any dimensional analytic surface σ in a closed n-dimensional manifold without singularity, by a trajectory which issues from a point P of σ, then for a certain constant τ the author proves that $\lim\limits_{n=\infty} t_n(P)/n = \tau$ for all points P save those which belong to a set of measure 0. In other words there is a fixed " mean time " of crossing on a general trajectory. The author next no longer makes the hypothesis of strong sensitivity and shows that $\lim\limits_{n=\infty} t_n(P)/n = \tau(P) \ldots (1)$ for all points P of the surface σ save for points of a set of measure 0, *i.e.*, there is a " mean time $\tau(P)$ of crossing " of σ for the general trajectory. This theorem can be extended by not restricting it to the analytic case, and, instead of a single surface σ, any measurable set σ^* imbedded in a numerable set of distinct ordinary surface elements with $v \cos \theta > d > 0$ throughout will serve, in which case $t^*(P)$ denotes the time from P on σ^* to the first later crossing of σ^*. Finally, the following ergodic theorem is established: For any dynamical system of the type (1) there is a definite " time probability " p that any moving point, excepting those of a set of measure 0, will lie in a region v; *i.e.*, $\lim_{n=\pm\infty} \bar{t}/t = p \leq 1$ will exist, where t denotes total elapsed time measured from a fixed point and $\bar{t}$ the elapsed time in v.

R. S. R.

2303. Proof of the Quasi-Ergodic Hypothesis. J. v. Neumann. *Nat. Acad. Sci., Proc.* 18. *pp.* 70–82, *Jan.*, 1932.—The author in a mathematical treatment seeks to prove and to generalise the quasi-ergodic hypothesis of classical Hamiltonian dynamics with the aid of the reduction recently discovered by Koopman [see Abstract 2301 (1932)] of Hamiltonian systems to Hilbert space and with the use of certain methods closely connected with recent investigations of the author of the algebra of linear transformations in this space. A precise statement of the results is given. [See also Abstract 2306 (1932).] R. S. R.

2304. Time Average Theorem in Dynamics. E. Hopf. *Nat. Acad. Sci., Proc.* 18. *pp.* 93–100, *Jan.*, 1932.—J. v. Neumann proved [see preceding Abstract] a theorem which in the dynamical case concerns the existence of the " time average " $f^*(P)$ of a function $f(P)$;

$$f^*(P) = \lim i\,.\,m \frac{1}{T}\int_0^T f(P_t)\,dt,$$

in the sense of congruence in the mean on Ω. His general theorem is: For any given point f of the Hilbert space an " average point " f^* is associated with the set of points $U_t(f)$, $-\infty < t < +\infty$ in such a way that $\lim_{T=\infty} \left\| \frac{1}{T}\int_a^{a+T} U_t f\,dt - f^* \right\| = 0$. If, in the dynamical case, the function $f(P)$ is the characteristic function of a measurable point set A, $f = 1$ on A, $f = 0$ on $\Omega - A$, f^* represents the mean time in which the wandering point P_t crosses A. G. D. Birkhoff discovered quite recently [see Abstract 2302 (1932)] that, in the case where A is an open point set, f^* is not only the limit in the mean, but the actual limit apart from a point set of zero measure. The evidence of this mean time of crossing establishes the actual proof of a fundamental hypothesis in classical statistical mechanics. The author gives in this paper simple and elementary proofs of these theorems. A. D.

2305. Dynamical Systems of Continuous Spectra. B. O. Koopman and J. v. Neumann. *Nat. Acad. Sci., Proc.* 18. *pp.* 255–263, *March*, 1932.—Reference is made to Koopman's conception of $E(\lambda)$ [see Abstract 2301 (1932)] which consists of a discontinuous part, the " point " spectrum and a continuous part. The present paper deals with the case where $E(\lambda)$ is continuous ($\lambda \neq 0$), but without $(E(\lambda)f, g)$ being necessarily equal to the integral of its derivative. The system is also assumed to be non-integrable in the sense that any f in Hilbert space $\mathfrak{h}$ such that $U_t f = f$ almost everywhere on Ω must be almost everywhere constant. It is shown that on the hypothesis stated all the initially observed properties of the system are obliterated by the lapse of time; the method of elementary mechanics of computing the final from the initial state must be replaced by the methods of probability. Contrary to the case of classical statistical mechanics, this situation is not dependent upon the system having an enormous number of degrees of freedom; this number may perfectly well reduce to two. R. S. R.

2306. Physical Applications of the Ergodic Hypothesis. J. v. Neumann. *Nat. Acad. Sci., Proc.* 18. *pp.* 263–266, *March*, 1932.—The mathematical result obtained by the author in an earlier paper [see Abstract 2303 (1932)] and the conditions for its validity are stated. The result obtained is in terms of " strong convergence " or convergence in the mean. Birkhoff has established the results in the domain of point set theory [see Abstract 2302 (1932)]. The author in this investigation establishes that the former is the more precise mathematical equivalent of the physical state of affairs. Further, the knowledge of the spectral resolution $E(\lambda)$ which is fundamental in Koopman's method, enables one to dominate the physical situation here completely; in particular it furnishes a numerical estimation of the degree of convergence of the limiting process connected with the ergodic hypothesis, whereas Birkhoff's existence proof is of a non-constructive character. R. S. R.

2307. Recent Contributions to the Ergodic Theory. G. D. Birkhoff and B. O. Koopman. *Nat. Acad. Sci., Proc.* 18. *pp.* 279–282, *March*, 1932.—Reference is made first to the ergodic hypothesis formulated by Boltzmann and Maxwell, the difficulties inherent in it shown by Kelvin and Poincaré and its effective modification later in the quasi-ergodic hypothesis by P. and T. Ehrenfest. The latter also noted that if the system is quasi-ergodic in the sense that everywhere dense path-curves exist, the mean time of sojourn along the path-curve through P in a given region M may vary discontinuously from path to path. In the introduction of the modern theory of real variables into dynamics the successive steps of Poincaré, Carathéodory, Birkhoff, P. A. Smith and Koopman are mentioned, their results being concerned with properties true " almost everywhere " in the sense of Lebesgue's measure. Neumann's work on a general theorem bearing fundamentally on the quasi-ergodic hypothesis led to the mean ergodic theorem, and provided the first general mathematical treatment which sufficed for the needs of the kinetic theory if metrical transitivity is granted. Finally, Birkhoff's results are summarised on the ergodic theorem, which, from the point of view of gross statistics, is equivalent in its implications to the mean ergodic theorem, is more far-reaching and proves that the relative time of sojourn along almost every individual path-curve exists and in addition goes outside the domain of the theory of the unitary U_t-operators in $\mathfrak{L}_2$. R. S. R.

2308. Remarks on the Ergodic Theorem of Birkhoff. A. Wintner. *Nat. Acad. Sci., Proc.* 18. *pp.* 248–251, *March*, 1932.—Reference is made to the results obtained by Birkhoff on an extremely general recurrence theorem in dynamics [see Abstract 2302 (1932)]. The author discusses the relation of Birkhoff's discovery to a more special result in connection with the theory of certain infinite matrices. These matrices represent, in the sense of Frobenius, the groups defined by the almost periodic function of Bohr for which the conditionally periodic motions of

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Staude and Stäckel and the limiting periodical (*grenzperiodisch*) functions of H. Bohr, also occurring in dynamics, are the simplest non-trivial examples. The method is, however, valid even if the recurrence character of the motion is weaker than almost-periodic (it holds, for instance, for functions representable only by Fourier integrals), and is connected in some points with several researches of N. Wiener. The results which may be obtained in this way do not yield the perfectly general theorem of Birkhoff because a certain recurrence property, called the Hadamard condition, is presupposed. If this condition is fulfilled, as in the simplest concrete cases mentioned, the results are not identical with the theorem of Birkhoff. Where the Hadamard condition is fulfilled, for all motions of the phase space the exceptional zero set not excluded by the general theorem of Birkhoff may be excluded. The ergodic system of Herglotz and Artin shows that for general dynamical systems the exceptional zero set of Birkhoff may effectively exist. R. S. R.

2309. Unified Field Theory of Gravitation and Electricity. A. Einstein and W. Mayer. *Preuss. Akad. Wiss. Berlin, Ber.* 25. *pp.* 541–557, 1931.—The concept of "parallelism at a distance" is dispensed with. At each point of a Riemannian space the tangent four-dimensional flat space is assumed to be immersed in a flat five-dimensional space, but the Riemannian space itself is not supposed to be immersed in another five-dimensional Riemannian space. In addition to the ordinary parallel displacement of a vector in the Riemannian space, a second type of parallelism with respect to the five-space is defined, and the relation between the two kinds of parallelism is laid down in three assumptions: (1) the invariant differential of the metrical tensor is zero for parallel displacements in the five-space, (2) if a vector is displaced by the Riemannian parallelism, the increment of its corresponding five-vector is normal to the Riemannian space and (3) this latter increment is zero if the vector is displaced parallel to its own direction in the Riemannian space. The coefficients of the connection in the five-space are then determined except that they involve an arbitrary second rank antisymmetrical tensor, which is identified with the electromagnetic force. The paths of the five-space then give the equations of motion of charged particles and its " curvature " properties, yield the field-equations. The paths are connected with the field-equations by the assumption of the existence of an energy tensor. The field-equations are those of general relativity in a field containing electromagnetic energy. [See also following Abstract.] G. C. McV.

2310. Four-Dimensional Interpretation of the Unified Field Theory. J. A. Schouten and D. van Dantzig. *K. Akad. Amsterdam, Proc.* 34. 10. *pp.* 1398–1407, 1931.—The authors show that the Einstein–Mayer field-theory [see preceding Abstract] can be converted, in its essentials, into a purely four-dimensional theory by the use of a projective geometry in the tangent flat four-space which exists at each point of a Riemannian space. By means of a suitable number of assumptions as to the character of this projective geometry the field-equations and equations of motion of charged particles of the general relativity theory are obtained, as in the Einstein–Mayer theory. G. C. McV.

2311. Unified Field Theory of Gravitation and Electricity. P. Straneo. *Accad. Lincei, Atti,* 15. *pp.* 77–82, *Jan.* 3, 1932.—The author overhauls and amends his three previous papers [see Abstract 3722 (1931)].

He has now reached exact results instead of approximations only. The distortion which represents in space-time the electric part of physical phenomena has the characteristic of disturbing to a minimum extent the geometry of the Riemannian space-time without distortion, representing the phenomena of ponderable matter. [See following Abstract.] A. D.

2312. Unified Field Theory. L. Infeld. *Accad. Lincei, Atti*, 15. *pp*. 157–160, *Jan*. 17, 1932.—The author, referring to Straneo's papers [see preceding Abstract] points out that he had himself arrived at the same conclusions in 1928, in the course of a study of the various 4-dimensional geometries which would lead to the Maxwellian and to the gravitational equations. Of these, Straneo's geometry is of class I, Weyl and Eddington's of class II, Infeld's of class III, and Riemann's of class IV. It seems impossible, however, to apply the undulatory mechanics. A. D.

2313. Electrons in Gravitational Field. T. Takéuchi. *Phys. Math. Soc., Japan, Proc*. 14. *pp*. 89–92, *Feb*., 1932. *In English*.—A calculation of the electromagnetic-energy tensor due to an electron at rest in Euclidean space, when a certain set of coordinates are used, corresponding to an observer " at rest " in the field of a uniform gravitational force. G. C. McV.

2314. General Relativity. B. Hoffmann. *Rev. Modern Physics*, 4. *pp*. 173–204, *Jan*., 1932.—The fundamental ideas and assumptions, *viz*., the significance of the expressions, velocity of light, rotation, relative radial motion, and the manner in which the gravitational potentials are to be measured, are briefly discussed in a treatment of the theory which is kept as free from mathematical symbolism as possible. J. S. G. T.

2315. Deflection of Light by the Sun. A. Danjon. *Comptes Rendus*, 194. *pp*. 252–255, *Jan*. 18, 1932.—Under the assumption that the observed displacement of the positions of stars observed during total solar eclipses is due partly to the true deflection, partly to a scale correction for the negatives, it is calculated that the true deflection amounts to 2″·05. G. C. McV.

2316. Relativity and Quanta. Mariani. *Comptes Rendus*, 194. *pp*. 685–687, *Feb*. 22, 1932.—The principle of relativity can be generalised, and simultaneously the dualism between waves and corpuscles can be interpreted by the adoption of two postulates, *viz*., (1) the observed relationship between an observed system and a system of reference is one of contact interpreted analytically and (2) natural laws are the invariants characterising a continuous group of transformations of contact. J. S. G. T.

2317. Expanding Universe. A. S. Eddington. *Phys. Soc., Proc*. 44. *pp*. 1–16, *Jan*. 1, 1932.—A non-technical account of the theory of the expanding universe with special reference to the author's calculation of the " cosmical constant," λ, of the general relativity theory, from the wave-equation of the hydrogen atom. From this value, a velocity of recession of 528 km./sec. per megaparsec, can be deduced for the average recession of spiral nebulæ. The observed value is 500 km./sec. G. C. McV.

METEOROLOGY, GEOPHYSICS AND ASTROPHYSICS.

2318. Solar Radiation as a Meteorological Factor. H. H. Kimball. *Monthly Weather Rev.* 59. *pp.* 472–479, *Dec.*, 1931. *Paper read before the Am. Assoc. for the Advance of Science, Dec.*, 1931.—Variations in the earth's solar distance cause variations in the intensity of solar radiation at the outer limit of the earth's atmosphere of very nearly ± 3·5 %, with the maximum early in January and the minimum early in July. Variations in solar declination cause seasonal variations in the daily totals of solar radiation as measured at the surface of the earth, the ratio of the amounts at summer and winter solstices being small at the equator, but increasing rapidly at higher latitudes to 40 at Sloutzk. After explosive volcanic eruptions the great amounts of dust thrown into the atmosphere, some to great heights, have diminished the intensity of direct solar radiation at the earth's surface by 15 % to 25 % for periods of several months. This gave rise to a slight cooling of the earth in 1883, 1888–91, 1902 and 1912. The absence of these eruptions since 1912 led Ångström to expect that the small amount of dust now in the stratosphere should lead to a slightly higher temperature. To various periodicities of 68 to 8 months, and short period trends of average length 5 days giving variations in solar radiation of under 1 % Abbot attributed the major changes in weather. The author disagrees with this view and considers these major changes are due to differences in the intensity of solar radiation in equatorial and polar regions. This gives rise to a gravitational flow of cold air equatorwards, which is turbulent in character, especially in winter when the temperature-difference is most marked. Studies of this air flow, and especially during the Polar Year 1932–33, should lead to great advances in knowledge. R. S. R.

2319. Solar Activity and Atmospheric Changes. H. H. Clayton. *Gerlands Beitr. z. Geophys.* 35. 2. *pp.* 151–152, 1932. *In English.*—After a reference to the work of others in this subject the author summarises his own results. Increase of solar radiation or increase of relative sunspot numbers produces (1) a fall of pressure in the equatorial belt 20° N.–20° S. and above 65° N. and S., and a rise in the belts 40°–60° N. and S., (2) an increase in the pressure contrasts of sea and land, (3) changes at the main centres of action, and (4) drift of detached high- and low-pressure areas from the centres of action. These pressure changes cause changes in the atmospheric circulation, in cloudiness and rainfall and thence, a fall of temperature in the equatorial belt and a rise in the belts 60°–70° N. and S. R. S. R.

2320. Pyrheliometer Adapted as Solarimeter. L. Gorczynski. *Rev. d'Optique*, 11. *pp.* 22–28, *Jan.*, 1932.—One thermoelectric pile is mounted on a movable tube so as to serve as a pyrheliometer (surface normal to sun's rays), or solarimeter (surface horizontal). An arrangement also allows of shading it, or of exposing it under various coloured glasses. The method of use is illustrated. C. A. S.

2321. Atmospheric Optical Measurements in Ilmenau. C. Jensen. *Gerlands Beitr. z. Geophys.* 35. 2. *pp.* 166–188, 1932.—Details are given of atmospheric optical measurements made in Ilmenau by

F. Schwab in 1909 and 1910, and essentially the paper is concerned with the working up of the observations of the Arago, Babinet and Brewster neutral points. Where possible the results are compared with those obtained at Hamburg, Potsdam, Arnsberg, Davos and Catania. Summer and winter values are compared, the difference arising from the greater atmospheric purity in winter, and especially the seasonal influence on the Arago point is shown. For the Babinet distance the relation is sought with solar heights, particularly the higher levels and in the range $+15\cdot5°$ to $+32\cdot5°$. This is also done for the Brewster distance and these values are compared with those for other places with different degrees of atmospheric purity. Conclusions are sought for a larger number of days on the relation between zenithal height of the earth's shadow and solar height where consideration is given, especially to the degree of atmospheric purity. R. S. R.

2322. Theory of Eddy Diffusion in the Atmosphere. O. G. Sutton. *Roy. Soc., Proc.* 135. *pp.* 143–165, *Feb.* 1, 1932.—Reference is made to the failure of earlier theories of atmospheric diffusion given by Taylor, L. F. Richardson and Schmidt, as shown by the enormous variation in the diffusivity and its rapid increase with the scale of the phenomenon. The author develops a theory of diffusion in a turbulent atmosphere based on the assumption that in following the motion of the particle the average size of the eddies concerned continually increases. It is assumed that the correlation between the motion to which the particle is initially subjected and the motion which it experiences at some later instant tends to vanish with increasing time, and the choice of an explicit form for the correlation coefficient in conjunction with a statistical theorem due to G. I. Taylor enables the theory to be developed, and expressions for the density distributions from various types of sources to be derived. It is shown that the formulæ fit in well with most of the observations, and that the new diffusion coefficient remains approximately constant for distances of travel up to 600 km. The theory is also applied to observations made on the visible outlines of puffs of smoke at great heights in the atmosphere. The suggestion is made that diffusion varies with the length of the observing period and it is shown that the formulæ successfully predict the results of long-period observations on the distribution of winds over northern Europe. R. S. R.

2323. Mixing of Gases in the Atmosphere. P. S. Epstein. *Gerlands Beitr. z. Geophys.* 35. 2. *pp.* 153–165, 1932.—The author establishes a differential equation to indicate the control of atmospheric diffusion by gravity and a complete theory of the equation is developed. The results are discussed numerically for H, He, A and CO_2. It is found that for the lower part of the atmosphere uniform mixture occurs so that density decreases with height z, according to the law $e^{-\mu z}$ where $\mu = Mg/RT$ and M is the mean molecular weight of the air as a whole. For very great heights the gases are quite unmixed, and the densities decrease independently according to the law $e^{-\nu z}$, where $\nu = mg/RT$ and m is the molecular weight of the respective gas. Tables are given of settling times to decide at what height the transition from one law to the other occurs. [See also Abstract 568 (1931).] R. S. R.

2324. Rôle of Regular Daily Pressure Oscillation in the Region of the Whole Atmospheric Circulation. E. Korselt. *Gerlands Beitr. z. Geophys.* 35. 2. *pp.* 217–223, 1932.—The author discusses objections raised to his theory of the origin of regular diurnal pressure oscillations because (1) the equilibrium of the air column in the vertical would be affected by lateral flow during the loss or gain of heat and (2) the amplitude of the pressure oscillation is not greater over the land where the temperature range is greatest. The normal daily pressure changes are disturbed by, (1) convection and turbulence in the lower layers due to surface heating, (2) horizontal irregularities in heating due to clouds, large woods, isolated hills or water and land surfaces, sea and land breezes and (3) differences of length of day in summer and winter and inclination at which solar radiation arrives, while the amplitude of the semi-diurnal oscillation decreases rapidly with latitude and at 50°–60° is lost in the irregular pressure changes. The author concludes that the vertical oscillations and movements connected with the daily pressure oscillations are an important factor in the chain of events which determines the general air interchange over the whole globe, and the pressure oscillations themselves can be seen as a manometer in the large thermodynamic machinery. R. S. R.

2325. Relative Humidity in Italy. G. Viola. *Accad. Lincei, Atti*, 15. *pp*. 55–61, *Jan*. 3, 1932.—It is generally believed that in Italy the higher the temperature, the drier is the air. The author goes, with tables and charts, through the records from 1887 to 1926, for Rome, Naples, Gaeta and Chiavari, and shows that there are persistent local anomalies in this respect. A. D.

2326. Theory of Extremely High Lapse Rates of Temperature near the Ground. S. L. Malurkar and L. A. Ramdas. *Indian Journ. Phys*. 6. *pp*. 495–508, *Feb*. 29, 1932.—Measurements of temperature were made at short-height intervals with a number of standard Assmann psychrometers on a few cloudless days in the summer and October, 1931, at Poona over an asphalted road where inferior mirages could usually be seen. Temperature was found to decrease very rapidly within a surface layer 10–15 cm. thick. The maximum lapse rates near the ground are of the order 1°–2° C./cm. Above this layer temperature-variation is very small and is almost constant within a small distance. A mathematical solution of the surface problem is given by consideration of the balance in an elementary layer between the heat received by conduction or convection and the net loss of heat by radiation. The variable part of the temperature ϕ is given by $\phi_0 \sinh \alpha(h-z)/\sinh \alpha z$ where ϕ_0 is a constant, h the thickness of the surface layer, z the height above ground, and α a constant involving the constants of temperature radiation, convection and absorption of radiation by water vapour in the atmosphere. The observed temperature distribution agrees fairly well with this solution. In a discussion of inferior mirages observed on the asphalted road, the temperature observations confirm the values required for the changes of refractive index to produce the mirage. R. S. R.

2327. Lunar Atmospheric Tide at Bombay, 1873–1922. S. K. Pramanik. *Indian Met. Dept., Mem*. 25. 8. *pp*. 279–289, 1931.—The hourly values of barometric pressure used in the determination of the lunar atmospheric tide were obtained from the tabulations of a Kew pattern photographically-recording barograph at the Colaba Observatory. Computations were made on lines similar to those adopted by Chapman in his determinations of the lunar atmospheric tide at other places [see Abstract 2085 (1928)]. The results obtained indicate that (1) the annual mean lunar atmospheric tide at Bombay is purely semidiurnal, as found for many other places, and can be expressed for this 50-year period quite closely by 49 sin $(2t + 81°)$ microbars, the maximum pressure occurring about 19 min. after the moon's transit; (2) there is a large variation in the semidiurnal component from one month to another; (3) the seasonal tide is purely semidiurnal, the amplitude and phase varying from one season to another in a fairly marked manner; (4) the varying distance of the moon does not introduce any appreciable diurnal tide, but the amplitude of the semidiurnal tide increases markedly from apogee to perigee and there is a small decrease in phase; (5) there appears to be a diurnal tide depending upon, and changing sign with, the declination, while the semidiurnal tide decreases, but does not change sign with, declination; (6) the large seasonal variation and the irregularities in the distribution of the amplitude and phase cannot be accounted for by a simple theory; and (7) the lunar atmospheric tide is affected by the tides in the ocean and solid body of the earth. R. S. R.

2328. Modified Mercalli Earthquake Scale of 1931. H. O. Wood and F. Neumann. *Seismological Soc. of America, Bull.* 21. *pp.* 277–283, *Dec.*, 1931. *Reprint.*—This scale, worked out at Pasadena, is less detailed than the Rossi–Forel scale for slight earthquakes, I–VI corresponding to R.F. I–VII, more detailed for severe earthquakes; VII–XII = R.F. VIII–X. C. A. S.

2329. Bibliography of Seismology. E. A. Hodgson. *Dominion Observat., Ottawa, Publ.* 10. 12. *pp.* 191–210, *Oct.–Nov.–Dec.*, 1931.

2330. Mechanism of the Production of Seismic Waves and Existence of a Quadruple Source at the Focus. M. Ishimoto. *Imp. Acad. Tokyo, Proc.* 8. *pp.* 36–39, *Feb.*, 1932. *Tokyo Univ., Earthquake Research Inst., Bull.* 10. 2. *pp.* 449–471, *May*, 1932.—Various models for initial movements at the focus of a seismic disturbance are discussed and two kinds of active forces deduced, *viz.*, those due to the radiating magma at the focus and those due to the diminution of hydrostatic pressure. H. H. Ho.

2331. Pattern of a Contracting Earth. A. J. Bull. *Geolog. Mag.* 69. *pp.* 73–75, *Feb.*, 1932.—The contraction patterns produced by a stretched rubber sphere or a rubber sheet attached to a ring and stretched over the top of a cylinder, the rubber being coated with wax, gelatin, etc., consist predominantly of three " anticlines " meeting at a point. Such an arrangement not being characteristic of terrestrial mountains it is concluded that the structures of the earth's crust have not been produced by general contraction. C. A. S.

2332. Geological Problem in Heat. F. C. Carstarphen. *Mines Mag.* 22. *pp.* 15–17, *Feb.*, 1932.—Fourier methods of analysis were applied to determine the temperature of a lava stream. For a layer with an initial temperature of 2600° F. and 2000 ft. thick the temperature at the middle point after 1000 years would be, (1) 1547·3° F. for a lava intrusion where the surfaces are maintained at 600° F. by the wall rocks, (2) 1263·7° F. for a surface layer where the ground beneath and the air cool it at equal rates and (3) 1846·6° F. for a surface layer if the ground beneath is a perfect insulator, while in this case the temperature of the bottom would be 2587° F. R. S. R.

2333. Solar Corona of January 14, 1926. H. v. Klüber. *Zeits. f. Astrophysik*, 4. *pp.* 1–18, *Feb.* 2, 1932.—In view of recent statistical researches into the various forms of the corona, a new study has been made of the eclipse photographs which were taken in 1926 in Sumatra by the joint Dutch-Indian-German expedition, and the coronal numbers deduced therefrom, according to Ludendorff's method, are found to agree well with those derived by himself from other sources. The photographs and isophotes are here reproduced and discussed. The plates of the Italian expedition to East Africa, when compared with the Sumatra plates of the English expedition, taken 2½ hours later, showed, according to Horn d'Arturo's measurements, some slight differences, and these are now confirmed by this study of the German plates. M. A. E.

2334. Study of the Solar Corona with the Spectroheliograph outside the Eclipses. B. Lyot. *Comptes Rendus*, 194. *pp.* 443–446, *Feb.* 1, 1932.—Measurements were made with two spectrographs and a spectroheliograph. The green ray on the west side of the corona is very large amounting to 1·3 Å. The curve of illumination is very regular and symmetrical about 5302·3 Å. The height above the solar disc is frequently 8′ or 9′, the intensity increasing to 2′ from the disc and then decreasing. The intensity varies much with latitude, being greatest towards the equator, feeble at about 30° and only occasionally visible at the poles. The intensity is from 70×10^{-6} to $2{\cdot}5 \times 10^{-6}$ of that of 1 Å. of the continuous solar spectrum. Occasionally there is a slow deviation from the rectilinear path. The red ray is larger than the solar ray and comparable with the green. It is visible to 6′ from the solar edge with intensity variations similar to those of the green ray, and a maximum on the western side amounting to 20×10^{-6} of that of 1 Å. of the continuous solar spectrum. The mean wave-lengths of the two rays are respectively $5302{\cdot}85 \pm 0{\cdot}03$ Å. and $6374{\cdot}75 \pm 0{\cdot}15$ Å. Other radiations if present were of intensity below 6×10^{-6} of the unit stated above. R. S. R.

2335. Angle "S" which Determines the Orientation of the Great Circle in the Search for Asteroids. B. Jekhowsky. *Comptes Rendus*, 194. *pp.* 530–532, *Feb.* 8. 1932.—A general mathematical solution is given for this problem. The procedure outlined simplifies notably problems relating to small planets, such as corrections to their orbits, their identification and the determination of the date of opposition. R. S. R.

2336. Property of the Equation Obtained when Equating to Zero the Distance of Two Planets which do not Meet in Two Real Points. M. Hamy. *Comptes Rendus*, 194. *pp.* 146–149, *Jan.* 11, *and pp.* 329–333, *Jan.* 25, 1932.—The paper forms an extension of an earlier one [see Abstract 1563 (1932)] in which the general equation and its roots were set out. The product of the two roots (ρ and ρ_1) is in general $> \cot^2 \psi/2$, where the eccentricity $e = \sin \psi$, with the exception that (1) where the mutual inclination of the orbits, $I > 0$, $\rho = \cot \psi/2$, and (2) where $\sin(\hat{\omega}_1 + w_1) = 0$, the product $\rho\rho_1 = \cot^2 \psi/2$, w_1 being the true anomaly and $\hat{\omega}_1$ the true perihelion measured with reference to the line of intersection of the planes of the orbit. In order that $\rho > \cot \psi/2 > \rho_1$, the perihelion of one planet must not lie on the line of nodes. Consideration is then given to the special cases when (1) either $\hat{\omega}$ or $\hat{\omega}_1 + w_1$ is zero and the other has the value π, (2) $I = 0$ and $\rho\rho_1 = \cot^2 \psi/2$ and the relative positions of the planets are found. R. S. R.

2337. Calculation of Hypotheses in the Gauss-Encke Method of Determining Orbits. T. Banachiewicz. *Comptes Rendus,* 194. *pp.* 355–357, *Jan.* 25, 1932.—In the Gauss–Encke method of calculating orbits a large part of the work relating to the determination by successive approximation of the ratio elliptic sector / triangle ought to be reserved for the determination of the position of the orbit and of associated quantities. The methods employed by Gibbs and Veithen are discussed and the errors involved in their results. The author suggests a method to obtain y, the known angle of Encke, and leads on to the Gauss auxiliaries, and thus replaces the determination by classical methods. [See two following Abstracts.] R. S. R.

2338. Determination of the Vectorial Constants of the Orbit from Two Heliocentric Positions of the Star. T. Banachiewicz. *Comptes Rendus,* 194. *pp.* 527–530, *Feb.* 8, 1932.—Gibbs' formula for the determination of the six vectorial constants is not entirely satisfactory on account of (1) one vector required for the solution of the formulæ being an unknown of the first order to be found from finite amounts, (2) the true anomaly being supposed known, but it is actually developed in the calculation, and (3) the formulæ not being symmetrical with reference to the two positions, and therefore their form not yet definite. These difficulties are met in a solution given by the author. [See preceding and following Abstracts.] R. S. R.

2339. Determination of the Orbit according to Heliocentric Positions. T. Banachiewicz. *Comptes Rendus,* 194. *pp.* 772–773, *Feb.* 29, 1932.—For the direct part of the problem of orbits (determination of positions from the elements) true anomalies are auxiliary in the logarithmic calculations, but for the inverse problem the true anomalies continue to act. To fix the direction of perihelion without preliminary determination of the star's position with reference to the perihelion, the author considers the orientation with reference to the directrice of the chord joining the two positions of the star. The solution given applies not only to the final part of the Gauss method with regard to the determination of the orbit, but at the same time to the final part of Laplace's method. [See two preceding Abstracts.] R. S. R.

2340. Probable Periods of Visual Double Stars whose Orbits are Unknown. D. Barbier. *Comptes Rendus,* 194. *pp.* 440–443, *Feb.* 1, 1932.—The formula given expresses the probable period in terms of distance, position angle, eccentricity and eccentric anomaly. The formula is tested first on stars of known orbit, 117 couples being used for the epochs 1870 and 1910, and the difference obtained in the orbits is due to uncertainty of the data. Next for stars with unknown orbits the period (P) and the eccentricity (e) are found to increase with the spectral type and e^2 appears to increase with log P although not clearly. [See Abstract 1569 (1932).] R. S. R.

2341. Calculations of the Orbits of Double Parabolic Stars. C. Volet. *Comptes Rendus,* 194. *pp.* 532–534, *Feb.* 8, 1932.—No double star is known yet with a clear parabolic orbit, but many having elliptic orbits are given with periods exceeding 400 years and having a relative motion which can be represented very satisfactorily in the mean as a parabola. The author obtains a solution on the lines given earlier for elliptic orbits [see Abstract 2206 (1931)], using rectangular coordinates and a choice of parameters leading to the most simple formulæ for the application of the method of mean squares. The procedure leads to an equation of the third order which has a single root corresponding to the possible orbit. R. S. R.

2342. Star Streaming. H. Mineur and P. Guintini. *Comptes Rendus*, 194. *pp.* 61–63, *Jan.* 4, 1932.—The motion of the stars with strong helium lines already studied by graphical methods [see Abstract 3764 (1931)] is recalculated analytically. G. C. McV.

2343. Radial Velocity of α Arietis. W. Schaub. *Zeits. f. Astrophysik*, 4. *pp.* 35–52, *Feb.* 2, 1932.—A period of 10·96 days, amplitude only ± 0·24 km./sec., is found from Bonn and Cape spectrograms taken for solar parallax. Evidence is obtained for the view that the star is a spectroscopic double with components of nearly equal brightness and small orbital inclination. A full discussion of the systematic errors of the plates is given. T. L. M.

2344. Milne's Method of Maxima. F. L. Whipple. *Harvard Coll. Obs., Bull. No.* 886. *pp.* 1–4, *Feb.* 1, 1932.—Milne has used the phenomena of maxima for the value of κ (the mass absorption coefficient in stellar atmospheres), and his theory requires that the optical depth τ should be kept constant from star to star. He therefore has to find a relationship between τ and r (the intensity ratio of line to continuous background), and he obtains that by introducing the Schuster atmosphere of pure monochromatic scattering in addition to his line-contour formula, and so obtains $\tau = 4r_\nu\{3(r_\nu + 1)\}^{-1}$, which defines the maximum of an absorption as occurring when the line width is greatest at a constant r determined by a chosen value of τ. The author shows that, when the solution is made to include the variation of an atmospheric temperature gradient, for $\tau = 0{\cdot}55$, r changes from 0·87 at class A0 to 0·38 at class M5; Milne's formula should give $r = 0{\cdot}70$ for all spectral types. A figure is given which shows the half-line breadths of the K line of calcium for $\tau = 0{\cdot}55$ and $\tau = 0{\cdot}70$ plotted against the spectral type; for the former the K line has a flat indefinite maximum, but more accurate measures with higher dispersion might affect this conclusion; for the latter, the observational data do not warrant any further reference. The equivalent value of the intensity ratio increases with the temperature. A. S. D. M.

2345. Motions in Scorpio-Centaurus Cluster. F. D. Miller. *Harvard. Colls. Obs., Bull. No.* 886. *pp.* 4–8, *Feb.* 1, 1932.—Space velocity components in the galactic coordinate system have been computed for 95 stars for which Lick radial velocities and spectroscopic parallaxes (C. Jane Anger [see Abstract 4137 (1931)] and W. B. Rimmer) are given. The two series of parallaxes are reduced to a single mean system and corrected for the K-term and solar motions. Two diagrams are given. The most striking features are, (1) an apparent duplicity in Kapteyn's first stream; (2) a fairly large number of random motions; and (3) a group of 8 stars travelling in P.A. 90°, four of which probably constitute an independent group. The double Kapteyn stream may arise from any one of three causes: abnormal dispersion in the space components due to errors in observational quantities; systematic errors in the spectroscopic parallaxes or an actual intermingling of two streams. The author considers that the last cause is not unlikely. A. S. D. M.

2346. Scorpio-Centaurus Cluster. Part III. Cecilia H. Payne, C. Jane Anger, Georgette Maulbetsch and G. W. Wheelwright. *Harvard Coll. Obs., Circ.* 365. [13 *pp.*], *Aug.* 24, 1931.—The intensities of the more conspicuous spectral lines of the stars in this cluster are summarised and discussed. It is found that the hydrogen lines are weaker for stars of high absolute magnitude, but the helium lines strengthen with high luminosity above their maxima and weaken below. The intensities of the helium lines may be used to determine absolute magnitude, and their behaviour demands a revision of some features in the current interpretation of the spectra of B stars in terms of the Stark effect. An attempt is made to base a consistent classification of B stars on the intensities of the silicon lines, but it is finally concluded that the hydrogen lines are the most satisfactory for this purpose. M. A. E.

2347. Analysis of Star Counts. B. J. Bok. *Harvard Coll. Obs. Circ.* 371. [40 *pp.*], *Nov.*, 1931.—A numerical method of analysis depending on the construction of " absolute magnitude and logarithm of parallax " tables for a given luminosity curve for photographic magnitudes. The mathematical analysis is of the simplest type, but is shown to be sufficiently accurate considering the intrinsic uncertainty of all such analysis. The effect of changes in density and interstellar absorption are not separable in star counts, but it is shown that the assumption of constant absorption together with uniform density around the sun is not tenable. The evidence is in favour of a local cluster and of an interstellar absorption of 0·40 magnitude per 1000 parsecs. The local cluster appears to be elongated in a direction 90° away from the galactic centre. The analysis also clearly reveals the Scutum Cloud as one of great density, about 2500 parsecs from the sun. Various problems in connection with the analysis are discussed, and it is pointed out that the method is suitable for the determination of the distances of dark nebulæ. G. C. McV.

2348. Breadths of Spectral Lines of Hydrogen. P. Rossier. *Arch. des Sciences*, 137. *pp.* 5–23, *Jan–Feb.*, 1932.—A discussion of 463 spectrograms from about 400 stars taken on 313 plates with the Schaer-Boulanger objective-prism of the Geneva Observatory mounted on the Plantamour equatorial. For each star is measured the spectrum length and breadth of lines visible (hydrogen and sometimes calcium). The extreme lines obtained are H_β and H,, but the latter is rare and therefore ignored. H_ϵ and H (calcium) are confused on the plates. The accidental error of reading the border of a line is of the order of 10 μ, the breadth of the lines being of the order of 100 or 200 μ. Empirical measures of the line breadths are used, being the regions of most rapid variation of darkening as seen in the microscope; these being made by the same observer and apparatus should bear a definite relationship to the theoretical breadths and therefore serve as basis for study. The changes due to alteration in star magnitude or length of exposure are discussed. On most plates K of calcium is invisible, but on 125 it is seen as a line too narrow for measurement, and in 22 cases it is distinctly measurable. The reality of this anomaly seems certain. A relationship has been already established between spectrum length and stellar magnitude (exposure being constant), and the variations depend on atmospheric humidity, and therefore give a relationship between line breadth and the energy received by the plate. [See Abstracts 1505 and 3386 (1931).] The author develops this relationship and gives 8 diagrams of the relative and absolute breadths in functions of the spectrum length for H_β, H'_γ, H_δ, $H + H_\epsilon$, H_ζ, H_{η_1} and H_θ, and also the total breadths of H_γ, H_δ and $H + H_\epsilon$ in the same function. He gives tables of frequency and of relative breadths. A. S. D. M.

2349. Interpretation of Wolf-Rayet Spectra. B. Edlén. *Arkiv f. Mat. Astron. och Fysik, Stockholm,* 22*B*. 11. [4 *pp.*], 1932.—Discusses C. S. Beals' publication, *Dominion Astr. Obs. IV*, 1930, and ascribes a number of lines to the vacuum spectra of CIII, a few to CII, CIV, and others to N and O: only a preliminary publication. T. L. M.

2350. Evolution of a Rotationally Unstable Star. R. Gunn. *Phys. Rev.* 31. *pp.* 130–141, *Jan.* 1, 1932.—It is proposed that the wide separation of the components of many binaries is due to a large difference of temperature between the two hemispheres of each component just after fission. Tidal forces orient the two hot faces towards one another and the resulting asymmetrical loss of mass through radiation provides, it is suggested, enough kinetic energy to account for the formation of any type of binary. The bearing of the theory on Novæ and Cepheids is also discussed. G. C. McV.

2351. Internal Rotations in a Fluid Ring of Matter. P. Dive. *Comptes Rendus,* 194. *pp.* 58–61, *Jan.* 4, 1932.—The fluid ring is supposed to be rotating about an axis as a whole and is stratified in layers of constant density whose meridian sections form a system of concentric circles. It is shown that internal rotations exist in the ring sufficient to preserve the equilibrium. G. C. McV.

2352. Stability of a Slowly Contracting or Expanding Fluid Sphere. H. Roth. *Phys. Rev.* 39. *pp.* 525–529, *Feb.* 1, 1932.—It has been pointed out by Thomas [see Abstract 3379 (1931)] that, if a solution of the equations of equilibrium for a slowly contracting or expanding fluid sphere has been obtained, the exact conditions of dynamical stability can be applied without difficulty. A particular solution of the equations of radiative equilibrium for a fluid sphere contracting homologously without generation of energy has been obtained. The opacity was assumed to obey Kramer's formula. By assuming a central temperature and total pressure of the order of magnitude expected for stellar interiors, the logarithmic rate of contraction was adjusted so that the boundary conditions, *viz.*, $P = 0$, $T = 0$, for a finite r and m, were satisfied. This solution has been found to be dynamically stable (at least for radial displacements) for values of the ratios of specific heats of material between 5/3 and 1 corresponding to all possible values of the specific heat at constant volume of a perfect gas. AUTHOR.

2353. Disturbances in Stellar Atmospheres: ϵ Ursæ Majoris. P. Guthnick. *Preuss. Akad. Wiss. Berlin, Ber.* 19. *pp.* 618–662, 1931.—The observational material for the spectrum of this star and the measurements of luminosity by the photoelectric method are given in great detail. The observations were made during 1931. The spectrum is of type A2–A3, but the numerous lines it contains show variations of intensity and of structure which have a period of $5^{d} \cdot 10$. Certain lines, *e.g.*, the CaII line K, are at their maximum intensity when the majority are at their minimum, and *vice versa*; a few lines appear to have aperiodic variations. The radial velocity, computed from these variations, oscillates about 3½ km./sec.

with the period $5^{d}\cdot 10$. The luminosity measurements show no trace of the variation of $0\cdot 04$ magnitude, with period $0^{d}\cdot 95$, found in 1915–1916. Instead they show very rapid variations of $0\cdot 07$ magnitude. This latter effect probably masks any variation with the period $5^{d}\cdot 10$, but this variation must certainly be small, if it exists. The star is of the same type as α Canum Venaticorum. G. C. McV.

2354. Ionisation in Stellar Atmospheres. Part III. E. A. Milne and S. Chandrasekhar. *Roy. Astron. Soc., M.N.* 92. *pp.* 150–186, *Jan.*, 1932.—A further contribution to the study of model stellar atmospheres, the formula for the absorption coefficient now used being that obtained from physical theory. A number of problems involving different mixtures of atoms in various states of ionisation are dealt with. These problems apply to one-constituent and two-constituent atmospheres and a preliminary study of three-constituent atmospheres is given. The absolute magnitude effects in two-constituent atmospheres are treated in detail. The application of these models to actual stellar atmospheres gives results which agree, on the whole, better with observation than those of previous theories. The opinion is expressed that the model best suited to represent the actual conditions is the three-constituent atmosphere, a detailed analysis of which is not yet available [see Abstract 1114 (1929)]. G. C. McV.

2355. Model Stellar Photospheres. S. Chandrasekhar. *Roy. Astron. Soc., M.N.* 92. *pp.* 186–195, *Jan.*, 1932.—The theory of a one-constituent atmosphere in which first-stage ionisation has set in, and in which the absorption coefficient is that calculated from physical theory. The results are in general agreement with those previously found by Milne on the basis of an assumed value of the absorption coefficient. G. C. McV.

2356. Stellar Temperatures. B. Sticker. *Zeits. f. Astrophysik*, 4. *pp.* 53–60, *Feb.* 2, 1932.—The paper contains remarks on Kienle's work [see Abstract 4155 (1931)] on the statistics of stellar temperatures. It is contended that there is no discontinuous distribution of temperature. The bearing of this on globular and galactic clusters is also discussed. G. C. McV.

2357. Distribution of Stellar Luminosities. R. E. Wilson. *Astron. J. No.* 968. *pp.* 169–174, *Feb.* 16, 1932.—In order to re-examine the distributions of luminosity data now available on the basis of a normal error law, 5651 stars have been tabulated according to their types Oe to Mb, and counts have been made of their absolute magnitudes, as determined in various ways by various observers. The distributions appear to follow with fair accuracy normal error curves based upon a minimum of four distributions, represented by the main sequence, ordinary giants, super-giants and faint giants. This probably means that the masses of the stars within a type-group tend to cluster round certain values of mass. Eddington's mass-luminosity law apparently holds for main-sequence stars, but fails for white dwarfs, and perhaps it may fail for other distributions. In any case, the existence of several luminosity sequences must be recognised in studying stellar evolution. M. A. E.

LIGHT.

2358. Absorption of Ultra-Violet Light by Organic Substances. W. Goslawski and L. Marchlewski. *Acad. Polonaise Sci. et Lettres, Bull. No.* 4–5. *A. pp.* 383–391, *April–May,* 1931. *In English.*—Studies by means of the sector photometer the ultra-violet absorption of chloral in various solvents and of the three isomeric tri-hydroxy benzenes and their acetyl derivatives. Details are given of the various chemical operations involved. Beer's law is shown to hold for most of the substances studied. Discusses the effect on the position of the absorption bands of the introduction of various groups into the molecules. [See following Abstract.]
A. H.

2359. Absorption of Ultra-Violet Light by Organic Substances. A. Boryniec and L. Marchlewski. *Acad. Polonaise Sci. et Lettres, Bull. No.* 4–5. *A. pp.* 392–399, *April–May,* 1931. *In English.*—A description of the ultra-violet absorption of substances additional to those already studied [see preceding Abstract]. In this work heterocyclic substances such as pyrrol, furan, indol, etc., are examined and the absorption curve for each substance is given. A. H.

2360. Ultra-Violet Absorption of Solutions of Optically-Active Compounds. R. Lucas and M. Schwob. *J. de Physique et le Radium,* 3. *pp.* 43–56, *Jan.,* 1932.—A sensitive method of measuring weak absorptions is described, depending on the balancing of two photoelectric cells by means of a quadrant electrometer. The absorptions of camphor, fenchone, cyano-camphor and tartaric acid for given wave-lengths are studied in various solvents at various concentrations, and are shown to vary with solvent and concentration in the same way as the corresponding rotatory powers. In no case is Beer's law obeyed. The changes in absorption can be attributed to the effects of solvation, modifying the absorption spectrum but not the molecular structure, or to a plurality of molecular structures for the substances examined such as has already been assumed in order to explain the phenomena of their rotatory dispersions. In the case of tartaric acid, the influence of the pH is too marked to be ignored. The results are in accordance with the view that tartaric acid solutions contain several molecular forms in a state of equilibrium which is a function of solvent and of concentration.
C. B. A.

2361. New Method for the Determination of Nitrogen Peroxide. E. J. B. Willey and S. G. Foord. *Roy. Soc., Proc.* 135. *pp.* 166–181, *Feb.* 1, 1932.—The method devised depends upon the measurement by a potassium photoelectric cell of the light transmitted by a column of the gas concerned, and depends upon the fact that the specified visible region of the spectrum where NO_2 absorbs most strongly is close to that at which a potassium photoelectric cell is most sensitive. Using the Beer–Lambert absorption law $\log_{10}(I_0/I) = \epsilon cd$ where I_0 and I are the intensities of light transmitted at zero and measured absorption, ϵ the molecular extinction coefficient, c the concentration of the absorbing medium and d the length of the absorbing column in the path of the light. I_0 and I can be replaced by the corresponding photoelectric currents i_0 and i. A description of the apparatus, its action and calibration is given. It can supply estimations in concentrations of $1:10^5$ and upwards with high accuracy and in a few seconds. It is found that (1) for a given change of concentration dc, the change in i is greatest when c is small, (2) the maximum sensitivity for the given cell and spectral region is obtained when $d = 0\cdot4343/\epsilon c$ and $(I_0/I) = e$, and (3) the maximum accuracy is obtained when $(I_0/I) = 3\cdot6$. A number of practical applications of the method are suggested. R. S. R.

2362. Constitution of Dyes and their Colour Intensity. A. R. Peterson and W. C. Holmes. *J. Phys. Chem.* 36. *pp.* 633–641, *Feb.*, 1932. —Adopting the extinction coefficients of dye solutions as criteria of colour intensity, the specific and molecular absorptions of 65 dyes are determined in water and alcohol. On the basis of molecular absorption, triphenylmethane derivatives and pyronines are the most intensely coloured groups, followed in decreasing order by phthalines and thiazines, diazo and triazo dyes, oxazines and azines, and monazo dyes and indigotine, the last-named being relatively weak. On the basis of specific absorption, pyronines and thiazines are exceptionally intense. Within any group, molecular absorption is generally increased by substitutions which increase molecular weight or molecular complexity, while specific absorption is decreased. Certain regularities are noted, but, in general, the effects of substitutions appear variable and depend on a number of structural factors. C. B. A.

2363. Scale of Chromaticity. D. B. Judd. *J.O.S.A.* 22. *pp.* 72–108, *Feb.*, 1932.—The author has sought for a method of expressing the colour difference between two colours of the same brightness in terms of the number of " least perceptible differences " of colour included in the range between the two. The empirical relation found to give satisfactory results is $K\Delta E = |c_1 - c_2|$, where ΔE is the difference numeric required, $|c_1 - c_2|$ is the positive value of the numerically greater of the two quantities $|r_1 - r_2|$ and $|g_1 - g_2|$ and K is a constant approximately equal to 0·010. The values r_1, g_1 are respectively the red and green trilinear coordinates for one colour, r_2 and g_2 those for the other colour. The figures obtained by means of this relation have been found to agree satisfactorily with (*a*) the least perceptible wave-length difference data, (*b*) the least perceptible difference in dominant wave-length at constant purity, (*c*) the least perceptible difference of purity at constant dominant wave-length, (*d*) the least perceptible difference of colour temperature. A diagram is given for finding the number of " least perceptible differences " separating any two colours of the same brightness. Full details are included as to the conditions under which the observations were made and a full Bibliography is appended. J. W. T. W.

2364. Reflection and Transmission Factors for Certain Metals obtained by Sputtering. A. de Gramont. *Comptes Rendus*, 194. *pp.* 677–679, *Feb.* 22, 1932.—The reflecting and transmitting powers of certain metals are found after deposition *in vacuo* or in certain gases and also immediately after formation or after a lapse of time. Results seem to show that tin is preferable to silver in making large astronomical mirrors because no burnishing is necessary and the surface does not deteriorate so quickly. H. M. B.

2365. Measurement of the Optical Constants of Crystals in the Ultra-Violet. P. Sève. *Ann. de Physique*, 17. *pp.* 137–197, *Feb.*, 1932. —An apparatus for measuring in the ultra-violet those optical constants of crystals which depend on the differences of the principal indices, and the technique of its use, are described. By means of a system of quartz lenses, a quartz-fluorite doublet and two Wollaston prisms cemented with glycerin, an image of the interference pattern given by the crystal section in convergent multichromatic light (line-spectrum with continuous background) is thrown on the slit of a spectrograph. The spectra are crossed by dark fringes. The fringe of zero order corresponds to the point on the slit at which the image of the optic axis for the particular wave-length falls. The fringe which corresponds to the isogyre of the figures in convergent monochromatic light is identified in that it cuts the neighbouring fringes, which are annular. By turning a crystal cut normal to the acute bisectrix of the axes, and finding for each setting the wave-length for which a point on the slit has zero order, the dispersion of the axes can be studied. If the crystal plate is arranged so that the image of an axis falls in the centre of the slit, a spectrum is obtained on which the fringes are parallel to the lines; and the corresponding birefringence can be determined. The following results are given: (1) the double refraction of cleavage plates of gypsum, varying from 0·0085 in the red to 0·0108 at 2450 Å. with an inflexion at 3200 Å.; (2) dispersions of the axes of calamine and of barytes; (3) variation of birefringence relative to the bisector of the acute axial angle in barytes. The results suggest that barytes could be employed for the construction of quarter-wave-plates for use in the ultra-violet. C. B. A.

2366. Absorption Coefficient of a Weakly-Absorbing Crystal Plate. G. Szivessy and A. Dierkesmann. *Zeits. f. Krist.* 81. *pp.* 169–182, *Feb.*, 1932.—A half-shadow method for the measurement of the absorption coefficient of a weakly-absorbing crystal plate is described. The plate is placed between crossed polarising prisms in parallel monochromatic light, the angle γ between the vibration direction of the polariser and the faster vibration of the plate being chosen according to the phase difference in the plate. The emergent light is elliptically polarised, and the absorption coefficient can be deduced from the angle ϕ between the major axis and the faster vibration in the plate, and the ellipticity ψ. ϕ is obtained from measurements of γ and the rotation of the analyser required to bring it from extinction with the polariser to the position when its vibration direction is perpendicular to the major axis of the ellipse. ψ is obtained from measurements of phase difference [see Abstract 2650 (1931)]. A simple relationship exists between phase difference θ and ψ and ϕ. C. B. A.

2367. Optics of the Opals. E. Baier. *Zeits. f. Krist.* 81. *pp.* 183–218, *Feb.*, 1932.—The individual nuclei causing the colour effects in opals are investigated. To each nucleus corresponds a number of colour-producing reflection positions, and the poles of the reflecting surfaces are in a hexagyric or hexagyroidic relationship to one another. It is concluded that the nuclei consist of some form of calcite in a silica matrix. Various types of twinning are observed. The colours arise from Bragg reflections at lamellar planes, and the separation of these planes is determined. All the planes in a zone give with the base plane an intersection system with the same grating constant. The occurrence of a continuous spectrum in the reflected light is thence explained. The origin of the lamellar structure is discussed, and it is concluded that the calcite must be built up regularly of such planes with an ultramicroscopic separation. C. B. A.

2368. Refractive Index of Liquid Mixtures. Part I. Binary Systems containing Piperidine. N. A. Puschin and P. G. Matavulj. *Zeits. f. phys. Chem.* 158. *Abt.A.* 3–4. *pp.* 290–296, *Jan.*, 1932.—The refractive indices, *n*, of binary mixtures containing piperidine and phenol, *p*-chlorophenol, *o*-, *m*- or *p*-cresol, guaicol or thymol have been determined as a function of the composition *c*. In all cases except that of the mixture containing thymol the *n*—*c* curve exhibits a maximum, which, however, does not correspond with the composition of the compound formed, but is displaced somewhat towards the component of higher refractive index, a phenomenon often observed with viscosity-composition curves. If, on the other hand, the *dn*—*c* curves are plotted, where *dn* is the difference between the observed value of *n* and the value calculated additively, maxima are obtained which correspond with the composition of the compounds known from thermal data to be formed. The temperature-coefficients of the refractive index are linear between 16° and 60° for all the components studied. The temperature coefficients of the mixtures, however, are dependent on the chemical nature of the system and deviate considerably from the additive law; that of the system piperidine-guaicol, for instance, exceeds the arithmetic mean of the coefficients of the components by nearly 80 %. H. F. G.

2369. Variations in the Refractive Index of Benzene during Intensive Drying. J. J. Manley. *Phil. Mag.* 13. *pp.* 249–264, *Feb.*, 1932.—It is indicated that changes in the boiling-point of benzene produced by intensive drying should be accompanied by changes in other constants of the liquid, and a study is made of the refractive index. Preparation of the benzene employed as standard is described. μ_D is determined employing a spectrometer and hollow prism charged with benzene, this value (μ_D at 16·7° C. $= 1 \cdot 50377$) is then employed as standard. The changes to be expected with drying are too small to permit of their measurement with the spectrometer and use is made of a Jamin interferometer. The first experiment (employing phosphorous pentoxide as drying agent) shows μ to increase with time until a limiting value of $\mu_D + 0 \cdot 000236$ is reached, but eventually, after approximately four months, μ commences to decrease. The technique is then modified to prevent possible absorption of moisture at each observation and a curve results very similar to the previous one, but showing at the finish a gradual increase in μ following the decrease observed in the first experiment. Examination is made of the effectiveness of several other dehydrating agents, but these are found inferior to the original agent. A. H.

2370. Theory of Dependence of Refractive Indices of Non-Absorbing Substances on Changes of Density. N. Günther. *Phys. Zeits.* 33. *pp.* 175–177, *Feb.* 15, 1932.—A mathematical theory of the relation between the refractive indices of substances and their densities. An expression is found for the change of refractive index when there is a change of density in the direction perpendicular to that in which the light is propagated, and double refraction is indicated; when the pressure is uniformly applied in all directions no double refraction is produced. H. M. B.

2371. Refraction Equivalent of Fluorine. K. v. Auwers. *Zeits. f. phys. Chem.* 158. *Abt.A.* 5–6. *pp.* 411–421, *Feb.*, 1932.—The work of Schiemann on the refraction of fluorine [see Abstract 791 (1932)] is examined critically, and certain objections are raised against the method of deduction. While the equivalents given for the H_α and D lines are substantiated, lower values are suggested for the dispersion equivalents, but further work on aliphatic material is desirable before definite values can be attributed. A brief reply to the criticism is contributed by **G. Schiemann.** C. B. A.

2372. Double Refraction of Quartz along the Optic Axis. H. A. Ferreira. *Roy. Soc., Proc.* 135. *pp.* 214–223, *Feb.* 1, 1932.—The values of the refractive indices of quartz along the optic axis are given for 22 wave-lengths in the visible and ultra-violet region of the spectrum, from 6708 to 2345 Å. The mean of the two indices is compared with the refractive index of quartz for the ordinary ray, and it is shown that they are equal. The values of the angular separation produced by a specially constructed quartz prism, in the position of minimum deviation, are given for the same 22 wave-lengths. The bisecting plane of the prism was found to be perpendicular to the optic axis. The angular separation for sodium light was found to be 23″ instead of 27″ as given by Cornu in 1881. The comparison made between the new values of the angular separation and of the difference of the two refractive indices along the optic axis with the theoretical values calculated from Fresnel's theory of rotatory polarisation showed satisfactory agreement. H. N. A.

2373. Optical Rotatory Power of Vapours. Part I. Camphor and Camphorquinone Vapours in the Region of Absorption. T. M. Lowry and H. K. Gore. *Roy. Soc., Proc.* 135. *pp.* 13–22, *Feb.* 1, 1932.—The molecular rotations $[M]_{5893}$ of the vapours of camphor and of camphorquinone are respectively 83° at 180° C., and − 146° at 200° C. The dispersion curve for camphor vapour shows a sharp maximum, $[\alpha]^{180°} = 2000°$, at 3200 Å. followed by a reversal of sign at 3020 Å and a negative maximum, $[\alpha]^{180°} = -1860°$ at 2800 Å. A "step-out" on the short wave-length side of the positive maximum is in harmony with the fact that the circular dichroism of camphor in hexane solution is confined to the longer wave-length part of the absorption band. A solution of camphor in cyclohexane gives a similar rotatory dispersion curve. The same sequence of phenomena is also observed in the vapour of camphorquinone, where the corresponding data are $[\alpha]^{200} = -500°$ at 4950 Å., 4740 Å., and $[\alpha] = +300°$ at 4440 Å. respectively. C. B. A.

2374. Influence of Thorium Salts on the Rotatory Power of Tartaric Acid and of Tartrates. E. Darmois and Yeu-Ki-Heng. *Comptes Rendus,* 194. *pp.* 703–706, *Feb.* 22, 1932.—Measurements of rotatory power of mixed solutions of tartrates and thorium salts indicate that complexes exist, the most stable of which contains tartaric acid and thoria in molecular proportions. The corresponding complex ion is stable in presence of excess alkali. The strong rotations observed in presence of thorium salts are thus due to true chemical compounds, such as were described by Rosenheim. C. B. A.

2375. Rotatory Power of Amino-Acids as a Function of Acidity. E. Vellinger. *Comptes Rendus,* 194. *pp.* 718–720, *Feb.* 22, 1932.—The rotatory powers of glutamic and aspartic acids and of *l*-leucine and *d*-alanine as function of pH are calculated on the assumption that they are made up of the rotations due to the individual ions and to the undissociated molecule. A Darmois diagram of rotatory dispersion as function of pH drawn for each ion gives, in the case of glutamic acid, a series of straight lines which converge very accurately to a single point. It suggests that only two fundamental forms (kation and monovalent anion) exist, which is contrary to experiment. The dispersions of aspartic acid, leucine and alanine cannot be treated in this way. The dispersion for the undissociated molecule of the dibasic acids is almost the same as that of the divalent anion. C. B. A.

2376. Rotatory Dispersion. G. Araki. *Tokyo B.D., Sci. Reports,* 1. *pp.* 193–201, *Feb.* 29, 1932. *In English.*—A mathematical investigation of rotatory dispersion in a crystal lattice. C. B. A.

2377. Magneto-Optical Dispersion of Organic Liquids in the Ultra-Violet. Part IV. Acetic Anhydride, Normal Butyric Acid and Normal Ethyl Butyrate. W. J. Lewis and E. J. Evans. *Phil. Mag.* 13. *pp.* 265–283, *Feb.,* 1932.—The apparatus and methods employed have been described earlier [see Abstract 1167 (1931)]. Equations are obtained for both the natural dispersion and the magneto-optical dispersion of each of the three liquids. Values for e/m are obtained in each case, but these are much below the accepted value. A. H.

2378. Magnetic Rotatory Power of Blende and Measurement of Fields of Electromagnets with Pierced Pole-Pieces. A. Cotton, G. Dupouy and M. Schérer. *Comptes Rendus,* 194. *pp.* 405–409, *Feb.* 1, 1932.—Measurements on two carefully selected sections of blende (thickness about 1 mm.) give the value 0′·282 for Verdet's constant at λ = Hg5460. The ratios to this of the values at λ = Hg5790 and Hg4358 are respectively 0·863 and 2·057. The sections are then used to investigate the variation of field-strength between the pierced pole-pieces of a powerful electromagnet by measuring the magnetic rotations produced at various points. C. B. A.

2379. Temperature Variation of Magnetic Birefringence of Fused Aromatic Compounds. C. Salceanu. *Comptes Rendus,* 194. *pp.* 270–273, *Jan.* 18, 1932.—Curves relating magnetic birefringence and temperature from the melting point to about 150° have been determined in a field of about 39,000 gauss, for the mercury yellow line, for α-nitronaphthalene, and α- and β-naphthonitrile; $C_m \times 10^{12}/d$ (C_m being the Cotton–Mouton constant and d the density) at 100° is respectively 3·69, 3·10 and 4·29, that of naphthalene being 1·84. For diphenyl, triphenylmethane and benzil C_m is respectively 1·79 (independent of temperature to 150°), 0·89 (at 102°) and 4·72 (at 116°). On continued heating the birefringence of these three substances slowly changes, due perhaps to oxidation. C. A. S.

2380. Magnetic Birefringence and Molecular Anisotropy. S. W. Chinchalkar. *Indian Journ. Phys.* 6. *pp.* 563–572, *Feb.* 29, 1932.—The values of the magnetic anisotropy of molecules of organic liquids calculated on Langevin's theory from the Cotton–Mouton constant of magnetic birefringence and the depolarisation factor of light scattered by the liquids, are compared from substance to substance along with their optical anisotropies. The latter are of molecules in the vapour state, since the effective molecular anisotropy of liquids is not a true molecular constant, being influenced by the neighbouring molecules. The comparison shows that most substances follow the general rule that when a group is substituted in a molecule having the same sign of birefringence as itself, both the optical and magnetic anisotropies of the combination increase or decrease together; while if the group and molecule exhibit opposite signs, the optical anisotropy of the resultant molecule increases, and the magnetic diminishes. AUTHOR.

2381. New Type of Magnetic Birefringence. S. W. Chinchalkar. *Indian Journ. Phys.* 6. *pp.* 581–594, *Feb.* 29, 1932.—Aqueous solutions of cerium, praseodymium, didymium and erbium salts show a negative magnetic birefringence, which is proportional to the square of the field and comparable in magnitude with that shown by organic liquids. No effect is observed with gadolinium nitrate, but it is also obtained with a slightly acid solution of ferric chloride. Assuming an optical anisotropy for the Ce^{+3} ion, an attempt is made to apply the Langevin theory to the case of cerium nitrate, and a result of the correct order of magnitude is obtained. The solutions showing negative birefringence also show a negative Faraday effect. C. B. A.

2382. Fresnel Wave-Surface. T. Boggio. *Accad. Lincei, Atti,* 14. *pp.* 551–556, *Dec.* 20, 1931.—In his recent *Caratteristiche dei Sistemi Differenziali e Propagazione Ondosa* (Zanichelli, Bologna, 1931), Levi-Cività studies, among other things, the derivation of the Fresnel wave-surface equation from Maxwell's electromagnetic equations of the field. The author reviews Levi-Cività's methods, and shows by vectorial methods how to arrive more rapidly at the equation with partial derivatives which characterises the surface, and also shows, from the parametric equation, how to obtain an expression which leads to the Cartesian of the fourth order. A. D.

2383. Interference Fringes. R. Bruscaglioni. *Accad. Lincei, Atti,* 15. *pp.* 70–77, *Jan.* 3, 1932.—Shows how to find, from a series of interferograms, the amount of pure astigmatism of an optical system; and calculates the form of interference fringes obtained from a wave affected with pure astigmatism with reticulum of any orientation. A. D.

2384. Form of Shadow-Fringes. F. Villani and R. Bruscaglioni. *N. Cimento,* 9. *pp.* 23–32, *Jan.,* 1932.—Starting with Scandone's expression [see Abstract 1189 (1932)] for the form of shadow-fringes obtained with a network of any orientation interposed in the path of a wave affected with astigmatism and coma, discusses certain precautions necessary in order to deduce from the fringe-forms the characteristics of the optical system whence proceeds the luminous wave examined. A. D.

2385. Piezoelectric Quartz in Vibration. G. Wataghin and G. Sacerdote. *Accad. Sci. Torino, Atti,* 66. 14–15. *pp.* 424–427, 1930–1931.—An interferometer study of surface vibrations of piezoelectric quartz. The absence of an acceleration-Doppler effect is established for accelerations up to the order of 10^8 cm./sec.^{2}. A. D.

2386. Application of Piezoelectricity to Microscopy. E. H. Synge. *Phil. Mag.* 13. *pp.* 297–300, *Feb.,* 1932.—A method has already been suggested by the author [see Abstract 1883 (1931)] whereby a microphotograph may be built up on the principle of a telephotograph, the scanning being done mechanically. It is now suggested that two quartz crystals, each subjected to a regularly changing potential, could be employed to perform the scanning. The suggestion is also made that a fluorescent particle might be used to produce the investigating spot of light. A. H.

2387. Ring Lens. F. Jentzsch and C. Münster. *Phys. Zeits.* 33. *pp.* 179–181, *Feb.* 15, 1932.—The diffraction image of a small object produced by a ring lens is discussed, and its application to the measurement of the size of the object is described. In observations of non-circular objects the ring lens has a decided advantage over the double-slit method. C. B. A.

2388. New Micrometer. F. Krautschneider. *Zeits. f. Instrumentenk.* 52. *pp.* 74–77, *Feb.*, 1932.—The errors inherent in a micrometer depending on the lateral movement of a microscope are avoided by using a fixed optical system in which the final image is displaced across the focal plane of the eye-piece by the movement of a single aberrationless lens. The displacements of image and lens are proportional to one another. The simple theory of the instrument and an investigation of the limits of error are given. C. B. A.

2389. Sources of Monochromatic Red and Yellow Light. F. Esclangon. *Comptes Rendus,* 194. *pp.* 266–268, *Jan.* 18, 1932.—The electrodeless discharge does not operate a sodium or cadmium lamp satisfactorily unless it is heated from time to time. This necessity is avoided if the tube contains argon at a pressure of 0·1 mm. of mercury. The sodium or cadmium can then be replaced by zinc or mercury. The arc spectra of the metals are obtained. In this way with suitable screens cadmium and zinc give respectively the lines 6438 and 6362, of brilliancies 0·25 and 1·0 candle, and breadth 0·045 Å. The argon not only starts the discharge, but also lowers the temperature necessary for its passage; its action seems connected with its high resonance potential and the Ramsauer effect. C. A. S.

2390. New Source of Light for the Iron Spectrum. M. Pirani and R. Rompe. *Zeits. f. techn. Physik,* 13. 2. *pp.* 134–135, 1932.—An arc lamp is described in which electrodes of iron dust mixed with barium and calcium oxides, sintered together, are mounted inside a hard glass bulb in an atmosphere of helium or other inert gas, at a few mm. Hg pressure. Connected through a choke to mains at 220 volts a.c. the lamp lights itself and burns quietly, taking a current of 2·5 to 5 amperes. Such a lamp has a life of from 50 to 100 hours. It does not possess the disadvantages of ordinary iron arcs, *viz.*, necessity of frequently regulating and replenishing the electrodes, broadening, reversing and shifting of spectrum lines and Stark effects. Three spectrum photographs are reproduced. N. D.

2391. Motion Picture Projection from Continuously Moving Film. F. Tuttle and C. D. Reid. *J.O.S.A.* 22. *pp.* 39–64, *Feb.*, 1932.—A summary of the advantages claimed for non-intermittent projectors is given. This is followed by a list of questions which should be answered with regard to any projector of this type. The various projector types are then classified according to the optical means used to form a fixed image. Each type of projector listed is discussed especially with regard to two types of errors which have been noted. A. H.

2392. Validity of the Schwarzschild Relation as applied to the Use of the Logarithmic Sector. F. Twyman and A. Harvey. *Optical Soc., Trans.* 33. 1. *pp.* 1–7; *Disc.*, 7–8, 1932.—A direct experimental test is made of the Schwarzschild relation as applied to the logarithmic sector used in conjunction with a quartz spectrograph. The relation is found to hold within the limits of the experiment, from which it follows that the length of a spectral line on the photographic plate is proportional to the logarithm of its intensity. AUTHORS.

2393. "Spekker" Photometer for Ultra-Violet Spectrophotometry. F. Twyman. *Optical Soc., Trans.* 33. 1. *pp.* 9–16; *Disc.*, 16–19, 1932.—The design and construction of the "Spekker" photometer are described, special attention being paid to certain pitfalls of spectrophotometry which have been avoided in this instrument. AUTHOR.

2394. New Photoelectric Spectrophotometer. F. C. Smith and E. R. Holiday. *Optical Soc., Trans.* 33. 1. *pp.* 20–24; *Disc.*, 24–25, 1932.—The photometer described makes use of a device by means of which absorption measurements may be made in the ultra-violet region of the spectrum without recourse to calibrated wedges or sectors. The hydrogen discharge tube is used as the source of radiation. A photoelectric bridge is employed, one arm of which is controlled by a small fraction of the light falling on a third cell; the current from the latter may be measured galvanometrically. The two fractions are kept in constant proportion over the range of intensities used. AUTHORS.

2395. Energy Distribution in a Grating Spectrum. W. Dziobek and U. Schmieschek. *Zeits. f. techn. Physik*, 13. 2. *pp.* 122–124, 1932. *From the Reichsanstalt.*—Light from a Nernst filament is passed through a grating spectroscope, collected by a condensing lens and focussed upon an opal screen. Direct light from the same source is also focussed upon another opal and the brightness of the two compared by using a rotating sector and a Lummer-Brodhun photometer. A relative transmission varying from 50 % to 20 % is found. F. S.

2396. Electrical Measurement of Reflection Density. Part I. E. R. Davies. *Phot. J.* 72. *pp.* 57–73, *Feb.*, 1932.—A suggestion is put forward for a restatement of the definition of reflection density which recognises that the eye is involved in the measurement. An investigation is then made as to the possibility of constructing an instrument with which this measurement can be made. The main difficulty encountered is that, in order to obtain sufficient sensitivity, much more energy must be collected by the physical detector than is used in the visual observation. It is shown that the angle of the cone of light employed may be increased to 25° without introducing appreciable error, and that convergent light may be employed for the illumination of the specimen in place of the parallel light specified in the definition. The spectral response of the photoelectric cell is discussed, and a potassium-on-silver kathode cell is selected as suitable. A. H.

2397. Reflection Factors of Photographic Papers. C. Dunbar. *Optical Soc., Trans.* 32. 5. *pp.* 184–196, 1932.—Reflection factor curves for gaslight photographic papers with matt and glossy surfaces have been obtained for a fixed direction of view of 30°, this direction lying in the plane of incidence. The papers give not only a specular peak, but also a "throwback" peak whose maximum occurs when the directions of incidence and view coincide. The height of the throwback peak is related to the reflection factor of the paper at the angle of the throwback peak by a linear law.

By considering in turn the different components of the photographic paper, the throwback peak has been shown to have its origin in the baryta layer. The complete reflection factor surfaces for a fixed direction of view of 30° have been built up for two pieces of matt surface paper from the reflection factor curves in different planes. As various liquid suspensions also give a throwback peak, the peak may have its origin in some kind of scattering effect. AUTHOR.

2398. Comparison of Efficiencies of Photographic Shutters by a Photoelectric Cell Method. J. S. Anderson. *Optical Soc., Trans.* 32. 5. *pp.* 197–204, 1932.—The paper describes a method of comparing the efficiencies of shutters, incorporating photoelectric measurements of the total amounts of light passed by the shutters. Details of an application of the method to a new type of shutter are given. AUTHOR.

2399. X-Ray Emulsion. O. Bloch. *Brit. J. of Radiology,* 5. *pp.* 150–155, *Feb.,* 1932.—A discussion of the characteristics of emulsions employed for recording X-rays. A. H.

2400. Use of Fluorescence for Photometric Measurements in the Ultra-Violet. Measurements with a Photoelectric Cell Sensitised with Sodium Salicylate. A. Chevallier and P. Dubouloz. *Comptes Rendus,* 194. *pp.* 174–176, *Jan.* 11, *and pp.* 452–454, *Feb.* 1, 1932.—The glass walls of a photoelectric cell are coated with a fluorescent material; with a potassium cell sodium salicylate mixed with dextrin is most suitable. In this way radiation of wave-length 3900–1900 Å. is measured by the fluorescence produced thereby, that of longer wave-length directly. The method is used to determine the intensity of the fluorescent light as a function of the wave-length of the exciting light, giving with a Chalonge and Lambrey tube [see Abstract 1056 (1930)] a curve closely resembling that relating energy to wave-length in hydrogen [see Abstract 2742 (1929)]; also to determine the ultra-violet absorption spectrum of acetone, giving results in good agreement with those otherwise obtained. C. A. S.

2401. Polarisation of Mercury Fluorescence with Relation to the Hyperfine Structure of the Lines. V. v. Keussler. *Zeits. f. Physik,* 73. 9–10. *pp.* 649–657, *Jan.* 8, 1932.—The polarisation of the fluorescence radiation of mercury vapour is calculated on the basis of the term schemes given by Schüler and Keyston for the hyperfine structure of the resonance line 2537 ($6^1S_0 - 6^3P_1$) and the lines $6^3P_{0,1,2} - 7^3S_1$ and $6^3P_{0,1,2} - 7^3D_1$, and is compared with previous experimental determinations. The calculated degree of polarisation for the resonance line 2537 is 83·4 %, corresponding to an observed incomplete polarisation of 80 %. The rotation of the plane of polarisation in weak magnetic fields is in agreement with the *g*-values calculated for the individual hyperfine structure components from the Schüler–Keyston term schemes. J. E. K.

2402. Extinction of Fluorescence and the Change of Resonance Spectra into Band Spectra by the Addition of a Gas. O. Heil. *Zeits. f. Physik,* 74. 1–2. *pp.* 18–30, *Jan.* 22, 1932.—The extinction of the fluorescence by the rare gases has been compared, in the cases of Te_2, Se_2 and S_2, with the possibility of change from resonance series to band spectra. It appears that there is a kind of conflict between extinguishing and transferring collisions. Molecules whose fluorescence is strongly extinguished are little transferred (Se_2, Te_2). Molecules whose fluorescence is only slightly affected are rapidly transferred (S_2). Neither of the molecules alters its rotation or its vibration very greatly during collisions. Extinction implies the use of the energy of excitation for dissociating the molecules into normal atoms; it takes place when the energy of excitation is sufficient for dissociation. If this is not the case there is no extinction. The relations in the cases of I_2 and O_2 are discussed. An increase in the " collision sectional area," due to vibrational loosening, has been observed in the case of Te_2. [See also Abstract 2509 (1932).] H. N. A.

2403. Quenching of Mercury Resonance Radiation. Part II. Further Hydrocarbons and Nitric Oxide. J. R. Bates. *Am. Chem. Soc., J.* 54. *pp.* 569–576, *Feb.*, 1932.—The present work refers to hydrocarbons containing a larger number of carbon atoms representing the saturated, unsaturated and benzene hydrocarbons. Nitric oxide is included as a diatomic gas, which has so far not been measured by the particular improved method used in the present work. The hydrocarbons investigated are benzene, *n*-heptane, 2,2,3-trimethylbutane, 2-heptene and 3-heptene. The values of the effective cross-sections of these molecules are calculated. [For Part I see Abstract 849 (1931).] J. K.

2404. Effect of the Rare Gases on the Resonance Radiation of Sodium. L. v. Hámos. *Zeits. f. Physik,* 74. 5–6, *pp.* 379–387, *Feb.* 16, 1932.—The resonance fluorescence of Na vapour in presence of additional gases has been investigated. It was expected that proof would be obtained of the existence of forced passages from state to state, caused by collisions between the excited Na atoms and the atoms of the rare gases. The measurements, however, did not prove that such passages take place. It appears that the rare gases produce no measurable extinction of the fluorescence. The previously assumed extinction is to be looked on as a secondary action, due to strong broadening of the absorption line. The broadening due to helium could be calculated from these measurements. In conclusion, the relation between the broadening due to collisions and the pressure is discussed. H. N. A.

2405. Colouring and Phosphorescence of Carbonate and Oxide Phosphors. L. Wesch. *Ann. d. Physik,* 12. 6. *pp.* 730–742, *Feb.* 19, 1932.—Various phosphors were bombarded with kathode rays and X-rays. It was found that the activating impurity has no effect on the colouring produced, and that the colouring is due to the presence of alkali halide fluxes, and is characteristic of them. When $BaCO_3$, $CaCO_3$ and $SrCO_3$ as ground materials are compared it is found in the cases of the colouring of NaCl and NaF that the absorption maximum of the colour produced changes towards longer wave-lengths with increasing atomic weight of ground material metal. A comparison of the light sums of phosphors coloured by radiation or pressure with that of phosphors not so coloured, shows that the total light sum is unaltered by the colouring effect, showing in conjunction with the previous results that the alkali halide addition to phosphors has nothing to do with the phosphor centres. It is further shown that with alkali halides pressure or incorporation in another material such as $BaCO_3$ increases the light sum obtainable from them and often shifts the absorption band. The emission of alkali halides is not due to the usual activating impurities: a further paper will deal with this emission. J. E.

2406. K-Absorption Limits in Phosphors and a New Sensitive Method for Analysis of H.F. Radiation. L. Wesch. *Ann. d. Physik,* 12. 6. *pp.* 743–752, *Feb.* 19, 1932.—Since Rupp has shown that in the h.f. excitation of phosphors the liberated electrons are responsible for the effect and that the K-absorption head corresponds to the activating impurity [see Abstract 96 (1925)], a new sensitive method is offered for the detection of such impurities and for the investigation of their h.f. levels. An investigation of the relation between the intensity of X-rays and the light sum of phosphors shows that the latter increases with the intensity of radiation to a saturation value. With different wave-lengths the light sum curve is parallel to the mass absorption coefficient curve, and when a wave-length region including the K-absorption head of the activating impurity is traversed the light sum curve shows sharp maxima. A curious result is that with Bi and Pb as the activators there are two close maxima, apparently corresponding to the α- and β-absorption limits. Further, it has been shown that if a small trace of another metal is put into a phosphor the light sum wave-length curve shows maxima corresponding to the new metal K-absorption limits. [See also preceding Abstract.] J. E.

2407. Absorption, Fluorescence and Emission Bands of Caesium. R. Rompe. *Zeits. f. Physik,* 74. 3–4. *pp.* 175–186, *Feb.* 11, 1932.—Absorption bands have been found in Cs vapour at 8080, 7540, 7050 and 6226 Å. In fluorescence the group 7540 Å. appears. In the resonance lines as in the second doublet of the principal series an unsymmetrical widening appears in absorption and in emission from a discharge tube. J. E.

2408. Absorption Spectra of Hydronaphthalenes. S. Kimura. *Kyoto Coll. Sci., Mem.* 14. *pp.* 303–316, *Nov.,* 1931. *In English.*—Using a hydrogen discharge tube and a Hilger medium size quartz spectrograph a study is made of the ultra-violet absorption spectra of naphthalene and its hydro compounds. The results obtained are compared with those of Henri and other workers. It is concluded that naphthalene must be represented by a bicyclic structure. A. H.

2409. Absorption Spectra of Sulphur Compounds with Different Valencies. H. Ley and B. Arends. *Zeits. f. phys. Chem.* 158. *Abt.B.* 4–5. *pp.* 311–324, *Jan.,* 1932.—In continuance of previous work [see Abstract 1847 (1930)] the absorption spectra of the HS′ ion and sulphur compounds with different valencies were investigated. It was found that H_2S in solution possessed a selective absorption at $189\,\mu\mu$, and the absorption bands of the alkyl derivatives of H_2S were in the region of 190 to $225\,\mu\mu$. The salt formation from both hydrogen sulphide and ethyl sulphhydrate caused the absorption spectra to be displaced towards the red end of the spectrum. F. J. B.

2410. Absorption Spectrum of Iodine Bromide in the Visible Region. H. Cordes. *Zeits. f. Physik,* 74. 1–2. *pp.* 34–44, *Jan.* 22, 1932.—The investigation was carried out between 6500 and 4000 Å. The band heads were measured, and arranged in two series schemes. The maximum intensities of the absorption continua, which join up at the convergence limits of the two-band systems, lie at about 4050 and 4950 Å. The energy of dissociation of IBr amounts to 1·80 ± 0·03 volts (41·4 ± 0·7 k. cal.). The observed convergence limits of the visible ICl bands is explained in a similar manner to that of the IBr bands. The energy of dissociation of ICl is 2·043 ± 0·001 volts (47·12 ± 0·02 k. cal.) according to E. D. Wilson. The author attempts, using the above material, to explain the fluorescence observations on IBr vapour. H. N. A.

2411. Absorption Spectrum of I_2. I. I. Agarbiceanu. *Comptes Rendus*, 194. *pp*. 702–703, *Feb*. 22, 1932.—The absorption spectrum of I_2 is measured between 6450 Å. and 5230 Å. Twenty more heads of bands than were observed by Mecke in the same range are recorded, some of which were observed by him and not measured, others overlooked. The former coincide within experimental errors with the values calculated from Mecke's formula; the others are new terms. [See Abstract 2420 (1923).] C. B. A.

2412. Ultra-Violet Absorption Spectra of Solutions of Substituted Phenyluracils. Janet Evans. *Am. Chem. Soc., J.* 54. *pp*. 641–646, *Feb*., 1932.—The ultra-violet absorption spectra of phenyluracils having a substituent in the N–1 position differ from those of derivatives having a substituent in the N–3 position, and the difference may be utilised to distinguish between N–1 and N–3 substituted uracils of the type of 6-phenyluracil. The absorption band of 6-phenyluracil is less intense and lies further in the ultra-violet than that of 5-benzalhydantoin, in accordance with Henri's conclusions that the most reactive substances exhibit the strongest absorption and that the absorption bands are shifted towards the longer wave-lengths as the reactivity increases. H. F. G.

2413. Spectrum of Water in the Temperature Interval 20° to 220° C. and the Spectral Region from 1 to 3·2 μ. Blandine Stansfeld. *Zeits. f. Physik*, 74. 7–8. *pp*. 460–465, *Feb*. 23, 1932.—Studies historically and experimentally the behaviour of the 3 μ band of water between 20° and 220° C., and that of the 1·5 and 1·9 μ bands when the temperature is raised from 20° to 97° C., from 97° to 120° C. and finally from 120° to 220° C. The experiments of the author show that in the case of liquid water the bands are distinctly shifted when the temperature is changed, though in the case of the band near 3 μ the shift was masked by the Raman effect. In water vapour there was no shift in the bands at 1·414 μ and 1·881 μ when the temperature was raised from 120° to 220° C., while the band at 2·620 μ was only shifted to 2·600 μ. The bands are regarded as due to rotational vibrations of hydrogen in the water molecule. H. N. A.

2414. Comparison of the Rotational Vibrational Spectra in Organic Liquids and Vapours. Blandine Stansfeld. *Zeits. f. Physik*, 74. 7–8. *pp*. 466–475, *Feb*. 23, 1932.—The effect of the change of state from liquid to vapour has been studied. For the four substances, ethyl alcohol, formic acid, acetic acid and ether, observations have been made in the region from 1 to 2·7 μ, and in nitrobenzene from 1 to 3·8 μ. In the spectrum of any one of the substances many bands are found to be affected by the change of state, while others do not show this effect. In general shifts towards higher frequencies are found in passing from liquid to vapour, but a few bands are affected in the opposite direction. Some suggestions are made as to the origins of the bands. H. N. A.

2415. Excited Atoms and Absorption Spectra in Metallic Vapours. A. T. Williams. *Phys. Zeits.* 33. *pp*. 152–158, *Feb*. 15, 1932. —The absorption spectra of the vapours of Cu, Ag and Au have been studied, and the observed lines are tabulated and classified. The validity of the relation $N_1/N = e^{-E/RT}$, giving the ratio of excited atoms to the total in terms of the energy absorbed in volts, the gas constant and absolute temperature, is discussed and the dependence of the intensity of the lines upon the variation in the quantum numbers *l*, *j* and *r*. F. S.

2416. Continuous Spectra Produced by Kathode Rays. Part V. W. M. Cohn. *Zeits. f. Physik*, 73. 9–10. *pp*. 662–676, *Jan* 8, 1932.—High-vacuum X-ray tubes are investigated, and it is found that no blue glow is evoked when anti-kathodes are used of materials other than radioactive ones. When simultaneous bombardment of a solid surface with kathode and positive rays occurs, no blue glow is excited. The blue glow does occur, whatever the metal of the anti-kathode, when a quite small amount of gas is left in the tube (say 10^{-4} mm. Hg). The blue glow round the anti-kathode of a Lilienfeld tube is observed, when the gas-content of the tube is varied. At the same time as the blue glow, there also occurs a certain amount of sputtering round the anode, and to a less degree, round the kathode. Polarisation of the blue glow could not be observed. [See Abstracts 378 and 1229 (1932).] A. C. M.

2417. Infra-Red Spectra of Polyatomic Molecules. E. Teller and L. Tisza. *Zeits. f. Physik*, 73. 11–12. *pp*. 791–812, *Jan*. 15, 1932.—Degenerate vibrations of polyatomic molecules can have a mean rotation. It is shown that the interaction of this rotation with degenerate vibrations must be taken into account in explaining infra-red spectra, and that certain difficulties are removed (such as in the cases of the rotation fine structure of methane and the methyl halides). In particular it is emphasised that degenerate vibrations in which hydrogen atoms take part are so anisotropic that great care must be exercised in employing normal vibrations. A. C. M.

2418. Continuous Spectrum of Hydrogen Associated with Each of the Lines in the Balmer Series. B. Arakatsu, Y. Ota and K. Kimura. *Faculty of Sci. and Agric., Taihoku Imp. Univ., Mem.* 5. *pp*. 1–13, *Feb*., 1932.—An examination is made of the continuous spectrum of hydrogen as excited by a heavy condensed discharge and also by an electrodeless ring discharge. Astronomically it has been observed that the continuum extends into the region of the Balmer series, whereas the Bohr theory predicts that it should only commence at the series limit. It is found that the number of Balmer lines appearing is dependent upon conditions such as pressure, and that the continuous spectrum commences sharply with its maximum intensity at the position of the highest Balmer line appearing. As the pressure is increased the number of lines appearing decreases, and at the same time the edge of the continuous spectrum shifts correspondingly to the red. It is also observed that the intensity of the continuum is closely related to that of the Balmer series. Unsuccessful attempts are made to get a continuous emission in the region on the long wave-length side of H_α. A. H.

2419. Molecular Symmetry and Diffusion Spectra. J. Cabannes and A. Rousset. *Comptes Rendus*, 194. *pp*. 706–708, *Feb*. 22, 1932.—Observations of the depolarisation factor give the following results: I. For the angle α in the XY_2 group.—NO_2 (in nitrobenzene), 108°; NH_2 (in methylamine), 105°; and SO_2 (liquid), 118°. The value for SO_2 is widely different from that given by Bailey, Cassie and Angus on the basis of the infra-red spectrum [see Abstract 1535 (1931)]. II. The water band at 3240 cm.$^{-1}$ is depolarised, that at 3418 cm.$^{-1}$ is polarised. They thus correspond to two types of oscillation of the H_2O group. $\alpha = 23°$ [see Kastler, Abstract 3469 (1931)]. III. Molecules with a ternary axis.—The addition of an atom on a ternary axis (*e.g.*, $PCl_3 \rightarrow POCl_3$) introduces one symmetrical and one degenerate oscillation. The three frequencies for $POCl_3$ indicate (*a*) a symmetrical displacement of the chlorines, (*b*) an oscillation of the remainder of the molecule with regard to the chlorines and (*c*) an internal vibration in the P = O group, similar to that of the C–H in $CHCl_3$. C. B. A.

2420. Molecular Spectra and Spectroscopic Analysis. G. Piccardi. *Accad. Lincei, Atti*, 14. *pp*. 578–582, *Dec*. 20, 1931.—The methods chiefly in use for spectrum analysis depend on observation of the fine lines of atomic spectra. The methods cannot be rapid and simple, precise and sensitive unless the spectra are relatively simple, with lines of great persistence and situated in regions easily accessible to ordinary apparatus. These conditions are fortunately fulfilled by Li, Na, Mg, Ca, Sr, Ba, Al, Cu, Hg and others; but K and Rb, though their spectra are simple, have lines of but small persistence; and Ce has a spectrum of about 8000 lines, so fine that only about 6 or 7 of these can be made out by moderate concentrations. In spectra rich in lines, the identification of the elements becomes difficult, and so also the concentration of each; so much so that purely chemical methods are preferable. The rare earths present extremely complicated emission-spectra, and are difficult to identify by chemical methods, so that recourse must be had to their magnificent absorption-spectra. The author recommends relying habitually on absorption spectra, wherever possible. The bands are easily located. Their fine structure may be varied by electronic influences; but this does not interest the observer. From the distribution of intensities within a band may be drawn conclusions as to concentrations. A rigorous quantitative research may be carried out with much greater facility by using even mediocre band spectra than by using line spectra obtained with difficulty. The band-spectra method has been for years in use in fractionating work. A. D.

2421. Quantitative Spectral Investigation of Gas Mixtures. A. Gatterer. *Phys. Zeits*. 33. *pp*. 64–73, *Jan*. 15, 1932.—A special burette is described for mixing the gases, and six binary mixtures have been photographed in eleven steps of concentration, the blackening being measured with a microphotometer. To a first approximation the blackening is proportional to the logarithm of the concentration. A number of deviations are noticed which are due to emission by one component. It is concluded that the quantitative spectral analysis of a gas mixture is possible. F. S.

2422. Spectral Analysis with Glass Prisms. Part II. W. Kraemer. *Zeits. f. Elektrochem*. 38. *pp*. 51–53, *Feb*., 1932.—The investigation has been continued [see Abstract 1613 (1932)] using "cerium iron," tungsten carbide containing molybdenum, alloys of Ag, Au and Ni, a metal used for making resistances, of unknown composition, and brass. The wave-lengths of a number of suitable lines for several different elements were observed with the small spectrograph previously employed, and are recorded and compared with the values obtained by other observers. H. N. A.

2423. Band Spectroscopy and Photochemistry. R. Mecke. *Phys. Zeits.* 33. *pp.* 1–14, *Jan.* 1, 1932.—A discursive summary of recent work [see Abstracts 499 and 1414 (1931) and 258 (1932)]. T. H. P.

2424. Bands in Mixtures of Rare Gases and Metallic Vapours. H. Krefft and R. Rompe. *Zeits. f. Physik,* 73. 9–10. *pp.* 681–690, *Jan.* 8, 1932.—The bands were observed in the positive column of electric discharges in mixtures of Tl, In, Zn, Na, K, Rb and rare gases. The properties of the bands depend upon the rare gas used and also upon the atomic levels of the metal. The intensity of the bands, relative to that of the metallic lines, decreases with increase in current density. F. S.

2425. Negative Nitrogen Bands. D. Coster and H. H. Brons. *Zeits. f. Physik,* 73. 11–12. *pp.* 747–774, *Jan.* 15, 1932.—New measurements of the band spectrum of the N_2^+ molecule have been made, using a hollow-kathode tube excited by 1000 to 1500 volts. A large concave grating was used to photograph the bands, of which tables of observed values are given. Most of the bands are degraded toward the violet. Those with higher oscillation quantum number are degraded to the red, while a symmetrical band without head has been observed for an intermediate step. The Σ-doublet lines are classified according to electron spin. F. S.

2426. Band Spectrum of Beryllium Hydride. E. Olsson. *Zeits. f. Physik,* 73. 11–12. *pp.* 732–746, *Jan.* 15, 1932.—Nine bands have been analysed between λλ4800 and 5600, and assigned to the system $^2\Pi \rightarrow {}^2\Sigma$. The doublet separation of the $^2\Pi$ state is compared with the Hill, van Vleck formula. The band constants are given. Brings forward some considerations as to the possibility of calculating the dissociation energy from the rotational term constants. No actual proof of the existence of the isotope Be^8 has been obtained spectroscopically. H. N. A.

2427. Beryllium Spectra, BeI and BeII. Anna Ciccone. *N. Cimento,* 9. *pp.* 1–22, *Jan.,* 1932.—The spectra of BeI and of BeII have been measured from 2100 to 9000 Å., using a concave grating and two different spectrographs. The terms of the various series for both ions are tabulated, as well as the observed lines, classified into the usual series. There is an inter-combination line ($2^1S_0 - 2^3P_1$), analogous to those found in the Zn, Cd and Hg arc spectra which can be obtained in the electrodeless discharge. J. H. A.

2428. Band Spectrum of Barium Hydride. A. Schaafsma. *Zeits. f. Physik,* 74. 3–4. *pp.* 254–266, *Feb.* 11, 1932.—The spectrum of a Ba-arc burning in hydrogen was photographed with a 6-in. grating in the region 6500 to 6900 Å. The spectrum has been analysed and it is shown that it is the 0 → 0 band of the $^2\Pi - {}^2\Sigma$ system. The molecular constants are calculated and compared with those of other hydrides of elements in the second column of the periodic table. F. S.

2429. Band Spectra of Boron Fluoride. N. R. Tawde and R. C. Johnson. *Phil. Mag.* 13. *pp.* 501–504, *Feb.,* 1932. *Supplement.*—An attempt is made to excite the band spectra of the boron fluoride, BF, molecule, which is especially interesting because of the similarity which it should exhibit with the CO and N_2 molecules from the point of view of electronic structure. Two methods were used for the preparation of BF, one involving the use of CaF_2 and the other KBF_4. The two gas samples gave the same type of spectra. A tabulated list is given of the observed bands, which cannot be assigned to any known band systems and are therefore very probably BF bands. On account of low dispersion details of the band structures cannot be given; the bands do not appear to be similar to the CO and N_2 band systems. J. E. K.

2430. Arc Spectrum of Magnesium, MgI. F. Paschen. *Preuss. Akad. Wiss. Berlin, Ber.* 32. *pp.* 709–715, 1931.—The spectrum is analysed in a similar way to that of Al I [see Abstract 1973 (1932)]. The deepest terms are sought, and it is found that the $3^1P - n^1D$ series is "inverted." A table is given of the laws of this spectrum. F. S.

2431. Terms in the Arc Spectrum of Krypton. W. Gremmer. *Zeits. f. Physik,* 73. 9–10. *pp.* 620–622, *Jan.* 8, 1932.—The paper gives the author's analysis which is based on his previous observations [see Abstract 2499 (1929)]. Small deviations are shown from the analysis of Meggers, Humphreys and de Bruin [see Abstract 850 (1932)], which are discussed. F. S.

2432. Spectra of Rare Gases. E. Rasmussen. *Zeits. f. Physik,* 73. 11–12. *pp.* 779–790, *Jan.* 15, 1932.—The arc spectra of krypton and argon have been completed by new combinations and terms. A connection between the anomalies of the *d*-terms of these spectra has been recognised. F. S.

2433. Light Intensities of Neon Discharges. P. Johnson. *Phil. Mag.* 13. *pp.* 487–494, *Feb.*, 1932. *Supplement.*—The variation with gas pressure and current strength of the light emitted in various regions of the spectrum by a d.c. discharge in neon is measured by the use of colour filters and a photoelectric cell. The line intensities are not exactly proportional to current strength. From the observed variations of the intensity with pressure the mean energy of the electrons which excite the red and yellow light is calculated on the basis of a distribution formula for electronic velocities given by Townsend and is found to be about 12 volts. In order to account for the results on the metastable atom theory of the excitation of neon radiation one would have to assume the number of metastable atoms to be independent of the current. A continuous spectrum is observed whose intensity increases with the pressure; the mean excitation energy of this continuous spectrum seems to be about 5 volts; it cannot be produced by recombination since its intensity is directly proportional to the current. J. E. K.

2434. First Spark Spectrum of Cæsium (CsII). O. Laporte, G. R. Miller and R. A. Sawyer. *Phys. Rev.* 39. *pp.* 458–466, *Feb.* 1, 1932.—The resonance lines of CsII, as excited by a hollow-kathode discharge in helium, are photographed with a vacuum spectrograph. With the separations of these lines as guides electron configurations are assigned to the energy levels given by Sommer, and his scheme is extended. The coupling is of approximate (*jj*) type. A characteristic feature is the decomposition of the levels arising from the various configurations into two distinct groups due to the large separation of the $5p^5\,{}^2P$ of CsIII. Five of the eight resonance lines fit into Sommer's scheme. One level with $J = 0$, found in this investigation, completes the group of six $5p^5\,6p$ levels built upon the ${}^2P_{1\frac{1}{2}}$ limit. The classification, assignment of inner quantum numbers and identification of levels agree with theoretical considerations and predictions from the XeI classification. The remaining three resonance lines are due to transitions from the $5p^6\,{}^1S_0$ ground level to new $5p^5(s, d)$ levels built upon the ${}^2P_{\frac{1}{2}}$ limit. The ${}^3P_2$ and ${}^3P_1$ levels due to $5p^5({}^2P_{1\frac{1}{2}})$ (6*s* and 7*s*) are distinguished from the $5p^5({}^2P_{1\frac{1}{2}})$ (5*d* and 6*d*) levels. The ionisation potential is estimated as 23·4 volts. A. H.

2435. First Spark Spectrum of Mercury. R. Ricard. *Comptes Rendus,* 194. *pp.* 781–783, *Feb.* 29, 1932.—The results of McLennan, McLay and Crawford [see Abstract 1619 (1932)] are considered and the spectrum of the electrodeless discharge from 4000 to 6100 Å. is photographed. Four lines are attributed to HgIII. Several lines given by Naudé are now considered to belong to HgIV. F. S.

2436. Third Spark Spectrum of Arsenic (AsIV). K. R. Rao. *Roy. Soc., Proc.* 134. *pp.* 604–613, *Jan.* 2, 1932.—The spectrum is similar to those of ZnI, GaII and GeIII, and consists of a simple triplet and singlet system. The chief source employed was a condensed discharge through As vapour, in a capillary tube of about 0·5 or 1 mm. bore. This had to be constantly heated. In the extreme ultra-violet, below λ1400, a highly condensed spark *in vacuo,* between Al electrodes containing As, was employed. A Siegbahn vacuum spectrograph was used for this part of the spectrum. The lines of AsIV are feebly represented in a spark in hydrogen, and absent in a spark in air between two poles of the metal; this has made it possible to select the lines of this spectrum. About 60 lines in the spectrum of trebly ionised arsenic have been classified. The absolute value of the triplet and singlet terms have been determined, with the aid of two members of each of the sharp and diffuse series of triplets. The ionisation potential corresponding to the largest term $4s\,{}^1S_0 = 404369$ cm.$^{-1}$, is found to be about 49·9 volts. H. N. A.

2437. Mean Life of Cd Atom in the ${}^3P_1$ and ${}^1P_1$ Excited States. P. Soleillet. *Comptes Rendus,* 194. *pp.* 783–784, *Feb.* 29, 1932.—A jet of Cd atoms emitted by a furnace heated to 500° was excited in turn by the resonance lines 3261 Å. $(1^1S_0 - 2^3P_1)$ and 2288 Å. $(1^1S_0 - 2^1P_1)$. In the former case the jet was excited for a length of 3 to 4 mins., and in the latter only at the point of excitation. This agrees with calculated lives of 2×10^{-6} sec. and 10^{-8} sec. respectively. F. S.

2438. nhν Emission in Xenon and Thallium III. W. M. Hicks. *Phil. Mag.* 13. *pp.* 329–354, *Feb.*, 1932. *Supplement.*—A discussion of *nhν* emission [see Abstract 56 (1930)] in the spectra of xenon and thallium III undertaken in order to evaluate certain spectral constants. A. H.

2439. Emission of Aluminium and its Alloys. R. Hase. *Zeits. f. techn. Physik,* 13. 2. *pp.* 145–155, 1932.—The radiational properties of aluminium surfaces are investigated with reference to their dependence on temperature, wave-length, emission angle and surface nature. Artificially oxidised aluminium is found to radiate selectively in a very similar manner to the sapphire. By corroding the surfaces remarkably low values of the emission can be obtained. J. E. K.

2440. Theory of Intermittent Action. B. N. Biswas and D. K. Sen. *Calcutta Math. Soc., Bull.* 23. *pp.* 183–186, *Dec.*, 1931.—In a previous paper [see Abstract 2268 (1931)], *nhν* was deduced for the energy formula of a harmonic oscillator, which Heisenberg and others give $(n + \frac{1}{2})h\nu$.

The latter is now deduced from the theory of intermittent action and the case of the anharmonic oscillator is also considered. F. S.

2441. g(I) Factors of the Nuclei of Chlorine, Phosphorus and Aluminium. S. Tolansky. *Zeits. f. Physik*, 74. 5–6. *pp.* 336–343, *Feb.* 16, 1932.—The fine structure is investigated of certain lines of the spectra Cl II, PII, Al I and Al II which appear in a discharge tube whose kathode is cooled by liquid air. The only effect obtained is a slight broadening. It is concluded, taking into account that the elements concerned possess odd atomic numbers and hence, probably, a definite nuclear magnetic moment, that the *g*(I) factors of nuclei 27, 31, 35 and 37 are abnormally small. From this and other considerations it is probable that nuclear magnetic moments are not due to proton spin alone, but that something akin to orbital motion exists in nuclei. N. D.

2442. Dispersion of Light in the Neighbourhood of Quadripole Lines. J. Blaton. *Zeits. f. Physik*, 74. 5–6. *pp.* 418–428, *Feb.* 16, 1932. —The Kramers–Heisenberg dispersion formula is extended in such a way that it still remains correct in the neighbourhood of quadripole lines. A rule, analogous to the *f* summation rule, is also deduced for quadripole radiation. The theory developed is compared with the results of Prokofjew on certain forbidden lines of the alkali metals. Using theoretical work on these lines by Stevenson the author is able to conclude that they are pure quadripole lines, and not due to forced dipole radiation. It seems probable also that certain forbidden lines observed by Datta, and later by Sowerby and Barratt, in the absorption spectrum of the alkali metals are to be explained as quadripole lines. H. N. A.

2443. Intensity Ratio of Neighbouring Spectral Lines. Hildegard Stücklen. *Ann. d. Physik*, 12. 6. *pp.* 701–729, *Feb.* 19, 1932. —The diffraction images accompanying lines formed by a spectrograph are discussed with reference to their effect on neighbouring lines. It is shown that Rayleigh's theory is more closely followed in instruments with rectangular apertures than in those embodying circular ones. The paper is largely mathematical. F. S.

2444. Wave-Length Shifts of Spectral Lines of HgII. A. Imazato. *Tokyo B.D., Sci. Reports*, 1. *pp.* 179–192, *Feb.* 29, 1932. *In English.*—The wave-length shifts of HgII lines when the vapour is heavily excited at relatively higher pressure are investigated. Many lines are found to shift, for the most part, to the longer wave-length side. The shift is considered in connection with the spectral term relation. The results seem to show that higher levels suffer, in general, larger displacements than lower ones. In several lines of HgII, McLennan's interpretation [see Abstract 1619 (1932)] does not agree with that of Paschen or that of Naudé, and in the present experiment is found to be the more plausible. AUTHOR.

2445. Raman Effect with Metal Electrons. F. W. Loomis and J. G. Winans. *Zeits. f. Physik*, 73. 9–10. *pp.* 658–661, *Jan.* 8, 1932.— An unsuccessful attempt was made to get scattered light with modified wave-length when light was passed over a fresh mercury surface in a vacuum. A. C. M.

2446. Raman Effect in Inorganic Compounds. J. C. Ghosh and S. K. Das. *J. Phys. Chem.* 36. *pp.* 586-594, *Feb.*, 1932.—In order to examine the suggestion of Dillon and Dickinson [see Abstract 2731 (1929)], that ionised substances of allied chemical character give Raman lines whose frequency shifts decrease with increase of atomic number of the central atom of the anion, a study is made of several groups of inorganic compounds. It is found that for ions of the type XO_2, XO_3 and XO_4 the suggestion holds good. A. H.

2447. Raman Effect and Molecular Structure of Simple Inorganic Substances. A. Dadieu and K. W. F. Kohlrausch. *Phys. Zeits.* 33. *pp.* 165–172, *Feb.* 15, 1932.—The Raman spectra of ammonia, sulphur dioxide, hydrogen sulphide and carbon oxysulphide are examined, and the results obtained are discussed at length. The angle between the valency bonds, the length of the bonds, and the deformation constants are calculated for the groups: O: C: O, S: C: S, O: C: S, O: S: O, H . S . H, and . S . H. H. F. G.

2448. Raman Effect from the Standpoint of Unimolecular Reactions. A. Ganguli. *Phil. Mag.* 13. *pp.* 306–310, *Feb.*, 1932.—A theoretical discussion of the relative intensities of Stokes and anti-Stokes lines in the Raman effect. A fourth power formula is eventually considered preferable for Raman lines in the visible at ordinary temperatures. A. H.

2449. Raman Effect in Liquid and Gaseous CH_4. S. C. Biswas. *Phil. Mag.* 13. *pp.* 455–458, *Feb.*, 1932. *Supplement.*—Discussing the Raman effect for methane in both the liquid and the gaseous state, it is pointed out that, whilst one vibrational Raman line appears at 3071 cm.$^{-1}$ from the incident radiation in both states, there is also evidence for another line appearing at 2909 cm.$^{-1}$ in the liquid state and at 2914 cm.$^{-1}$ in the gaseous state. It is believed that this is due to the existence of two types of CH_4 molecules, and an examination of the work which has already been done on the ionisation process of CH_4 is taken to lend support to this view. A. H.

2450. Raman Spectra of Cyclo-Paraffins. M. Godchot, E. Canals and G. Cauquil. *Comptes Rendus*, 194. *pp.* 176–177, *Jan.* 11, 1932.—The Raman spectra are compared of cyclohexane, methylcyclohexane, the three dimethyl cyclohexanes and normal hexane. The monomethyl cyclohexane and the three dimethyl derivatives show great similarity to cyclohexane itself. Lines in the region 425–458 cm.$^{-1}$, and in the region about 1260 cm.$^{-1}$, are attributed to the cyclohexane nucleus. A. C. M.

2451. Complete Raman Spectra of Benzene, Cyclohexane and Octane. P. Krishnamurti. *Indian Journ. Phys.* 6. *pp.* 543–556, *Feb.* 29, 1932.—These liquids are studied, using two filters (*o*-cresol phthalein and uranine) separately. Frequencies of new lines are recorded at 687, 806, 1029, 1407 and 1477 cm.$^{-1}$, most of which correspond with infra-red maxima. Two faint lines unrecorded hitherto were found in cyclohexane, at 2351 and 2630 cm.$^{-1}$. In *n*-octane, a new frequency is found at 2733. The continuous spectrum between 2852 and 2938 cm.$^{-1}$ in cyclohexane and octane may be due to vibrations of H-atoms, influenced by free rotation about certain axes. A. C. M.

2452. Raman Spectra of the Simpler Hydrocarbons. S. Bhagavantam. *Indian Journ. Phys.* 6. *pp.* 595–604, *Feb.* 29, 1932.—The

Raman spectra of gaseous methane and ethane and of liquid propane and *n*- and *iso*-butane are studied. Methane exhibits lines of frequencies 2918 cm.$^{-1}$ (strong) and 3018 cm.$^{-1}$ (weak), of which the former corresponds with symmetrical expansion of the tetrahedron as a whole, and the latter with an unsymmetrical type of oscillation. A line at 993 cm.$^{-1}$ in the ethane spectrum is attributed to symmetrical oscillation of the two methyl groups; propane exhibits a line at 377 cm.$^{-1}$, in accordance with a triangular molecular configuration, and a strong line at 1453 cm.$^{-1}$ due to transverse oscillation of the hydrogen atoms; this frequency occurs in the *n* and *iso*-butane spectra as an intense and rather wide band. The Raman spectrum of *iso*-butane closely resembles those of chloroform and iodoform, in conformity with the probable similarity of structure.

H. F. G.

2453. Excitation Potentials of Light Metals. Part I. Lithium. H. W. B. Skinner. *Roy. Soc., Proc.* 135. *pp.* 84–108, *Feb.* 1, 1932.—The critical potentials of metallic lithium are found to consist of some low-voltage potentials and three critical values at 53·7, 56·2 and 60·1 volts corresponding to the excitation of LiK-radiation. The radiation emitted by metallic lithium has been studied by the photoelectric method, the K-radiation being found mainly to consist of a band running up to a maximum energy at 54·1 volts. The general characteristics of the spectrum of photoelectrons ejected by the radiation from Li are in accord with those of Rudberg, the photoelectrons largely predominating which have energy corresponding to only a few volts. A numerical comparison is satisfactorily achieved between the observed critical potentials of lithium metal and the calculated energy levels of the free lithium atom. It is shown that the effects of the crystal lattice on the motion through lithium of the incident electron beam which is used for the excitation of the radiation and of the electrons which are thrown from a K-, L- or M-shell in the excitation process, may have an important bearing on the interpretation of soft X-ray discontinuities. The true probability for a given excitation process of an atom in a solid is found to vary with the voltage of the exciting electron in a way quite analogous to the variation of the excitation function for the corresponding process in the care of a free atom. An Appendix contains the calculation of the energy constants of the lithium atom. H. H. Ho.

2454. Active Matter. G. Reboul. *Comptes Rendus*, 194. *pp.* 602–603, *Feb.* 15, 1932.—The action of activated bodies on the electroscope is exceedingly feeble, so that it cannot be affirmed that it may not be due to some secondary effect. The photographic plate, totalising the actions exerted during long exposures, is for this work far more sensitive than the electrometer. A range of experiments is described. A. D.

2455. Spectrograph, giving High Intensity, for Transmission of Non-Canalised X-Rays through Curved Mica Sheets. (Miss) Y. Cauchois. *Comptes Rendus*, 194. *pp.* 362–365, *Jan.* 25, 1932.—When an X-ray beam (which need not be sharply delimited) falls on the convex face of a mica sheet, curved into a circular cylinder whose axis is parallel to the intersection of the (001) planes with the reticular planes on which the reflections occur, sharp spectra can be obtained on a film carried on a focussing cylinder tangential to the mica and with double the curvature. A spectrograph built on this principle needs only three simple adjustments, *viz.*, the orientation of the mica on its cylindrical support, the parallelism of the axes of curvature of film and crystal and the setting of the focussing cylinder. The third of these need not be very exact—the film can even be replaced by a plane plate placed tangentially. The high intensity of the spectrum obtained makes the arrangement suitable for study of weak radiation, particularly from extended sources. C. B. A.

2456. X-Ray Study of the Nature of Solid Solutions. R. T. Phelps and W. P. Davey. *Am. Inst. Mining and Met. Eng., Techn. Publ. No.* 443. [14 *pp.*], 1932.—The lattice parameters and densities of a series of aluminium-silver alloys over the range of composition 90–100 % silver have been measured. Addition of aluminium to silver decreases the lattice parameter by an amount which is proportional to the amount of aluminium added, up to 5·4 % aluminium, when saturation is reached. Further addition forms aggregates of Ag_3Al of size sufficient to show X-ray diffraction patterns. It is concluded, after discussion of the above results, that in these solid solutions aluminium atoms are chemically combined with the adjacent silver atoms. F. J. W.

2457. X-Rays in Chemical and Industrial Research. G. L. Clark. *Indust. and Engin. Chem.* 24. *pp.* 182–190, *Feb.*, 1932.—The author endeavours to present the most recent chemical and industrial achievements with X-radiation. Mentions special cars with X-ray apparatus now used on German railways; they are run alongside locomotives, so that fire boxes and boilers can be examined radiographically in position. Deals with the use of high voltage X-ray tubes for finding flaws in thick masses of iron, and the employment of γ-rays from radium by Mehl for the same purpose. Other subjects dealt with are the application of X-ray data to theories of atomic structure; new types of X-ray tubes for chemical analysis by means of fluorescent, secondary X-rays; recent developments in chemical analysis from X-ray spectra; crystal structures; colloids; internal strain in crystals; effects of rolling and heat treatment of metals; shape of molecules; structures of cellulose, rubber, etc. H. N. A.

2458. Pseudo-Reflection of X-Rays. B. Demetrovic. *Comptes Rendus*, 194. *pp.* 699–701, *Feb.* 22, 1932.—It is shown that the black fringes observed at the edge of the shadow in radiographs of a convex screen can be explained completely by total reflection. [See Abstract 1255 (1932).] C. B. A.

2459. Absorption of X-Rays in Gases and Vapours. J. A. Crowther and L. H. H. Orton. *Phil. Mag.* 13. *pp.* 505–523, *Feb.*, 1932. *Supplement.*—Continues experiments primarily undertaken to investigate the relation between the total ionisation produced by the complete absorption of a beam of homogeneous X-rays in a gas and the ionisation potential of the gas [see Abstract 509 (1931)]. The mass absorption coefficients and relative ionisations of a number of gases and vapours have been measured with Cu and FeK-radiation. Atomic absorption coefficients have been deduced for eleven elements, and have been used to test the relation between atomic absorption and atomic number and between atomic absorption and wave-length. It is found that de Broglie's formula agrees well with the observations for elements in the first series of the atomic table, but breaks down for elements of higher atomic number, the measured absorptions being less than the values given by de Broglie's theory, the presence of the outer electrons appearing to produce a screening effect on the absorption of the K electrons. The relative total ionisation in different gases is found to be independent of the wave-length of the radiation employed. The efficiency of the ionising process is found to be high for elements which show little electron affinity, and is practically constant for other substances. E. E. F. d'A.

2460. Fine Structure of X-Ray Absorption Edges. D. Coster and J. Veldkamp. *Zeits. f. Physik*, 74. 3–4. *pp*. 191–209, *Feb*. 11, 1932.—The theory of simultaneous electron ejection is compared with Kronig's theory; the experimental evidence favours the latter. The maximum variation in the absorption coefficients within the region of fine structure is found to be Fe 19 %, Cu 13 %, Zn 7 %; in accordance with the rule that greater variation goes with higher melting point. For Zn the fine structure of the K-edge becomes less marked with increase of temperature, but up to 405° C. is almost unaltered within an energy range of 20 volts from the edge. The variation in the absorption coefficients in the L_{111}-absorption region is for Au 1·5 %, Pt 2·5 %, both smaller than for the K-edge of Cu. The positions of maxima and minima are the same for Cu, Au and Pt, after allowing for the variation in the grating constant. The L_{111}-absorption of Au and the K-absorption of Cu in a mixed crystal are found; the positions of maxima and minima again coincide. The variations of the absorption coefficients are here greater than for pure gold, and for the copper edge less than for pure copper. T. L. M.

2461. Compton Effect from the Classical Standpoint. S. Björck. *Zeits. f. Physik*, 73. 7–8. *pp*. 541–546, *Dec*. 30, 1931.—Shows that the Compton effect can be described in terms of the classical theory, if it is assumed that the photon is a classical wave, with energy $h\nu$ and length $\lambda = c/\nu$, held together in space. Such a " photon wave " when it is reflected by an electron, which moves backward with accelerated velocity, will change its wave-length, owing to the Doppler effect, in exactly the manner indicated by the Compton experiment. At the same time, in accordance with the Wichert–Stokes theory, a classical impulse wave will proceed from the electron during its acceleration period, and this will cohere with the reflected photon wave. It is suggested that the atomic nucleus absorbs classical energy of radiation, and sends it out in the form of a photon wave with energy $h\nu$. This release of a photon wave takes place when classical waves of the frequency ν are sent out by the whole atom, including its extranuclear electrons. The nuclear photon thus comes out united with a classical train of waves, with which it is coherent, and so is capable of interference, in a way which is somewhat analogous with the de Broglie electrons. H. N. A.

2462. Existence of the J-Phenomenon. I. Backhurst. *Phil. Mag*. 13. *pp*. 28–48, *Jan*., 1932.—Describes a comprehensive investigation of the subject, making use of a special X-ray tube and a full-wave rectification " constant potential " h.t. generator. No indication of J-phenomena was found, but the intensity of the scattered beam was found to be highly sensitive to changes in the h.t. voltage. Values of the proportionality factor for small percentage changes were determined for conditions of hardness and absorption under which the J-phenomena have been stated to occur. There seems to be no reason why the existence of such phenomena should be postulated. H. N. A.

RADIOACTIVITY.

2463. Electrolytic Deposition of Polonium from an Alkaline Medium. M. Haïssinsky. *Comptes Rendus*, 194. *pp.* 275–277, *Jan.* 18, 1932.—On electrolysing solutions of NaOH of varying concentration containing 2–4 × 10^{-9} gm. atom/l. of polonium with pure gold electrodes, 7·5 mg./cm.^{2}, previously kathodically polarised, the polonium is deposited on both electrodes at about the same velocity in the case of N NaOH; variation of concentration from normal in either direction diminishes the velocity for the anode, but that for the kathode is little affected. The critical potential of the anion varies little with the alkalinity, averaging + 0·53 (relative to the calomel electrode); that of the kation falls from − 0·21 for 0·28 N to − 0·45 for 4N-NaOH. In NaOH solution of concentration above 0·2 N polonium is mainly in ionic solution. Very little polonium is separable by centrifuging its solution in NaOH of concentration above normal. [See also Abstract 2558 (1927).] C. A. S.

2464. α-Radiation of Radiothorium, Radioactinium and their Derivatives: Complexity of α-Radiation of Radioactinium. Irène Curie. *J. de Physique et le Radium*, 3. *pp.* 57–72, *Feb.*, 1932.—By means of a Wilson expansion chamber, and with the ranges of α particles of polonium (3·87 cm.) and ThC′ (8·62) as standards the following ranges of α-particles have been determined: from RaTh 3·99 (there is no sign of complexity here): ThX 4·29; ThC 4·77; Tn 5·05; ThA 5·65; RaAc, α_1 4·66 and α_2 4·34 [see Abstract 3129 (1931)] with relative intensities as 1 : 1·08, and both seeming to correspond with formation of AcX, but with an apparent systematic deficit of about 15 %, which may, however, be due to insufficient statistics; AcA 6·53; AcX 4·26; An 5·73; AcC 5·51 [see Abstract 3857 (1931)]. It seems probable that complexity of α-radiation is connected with emission of γ-rays accompanying disintegration of the derived radioelement. Methods of preparing RaTh, RaAc and AcX are detailed. C. A. S.

2465. Passage of α- and β-Particles through Matter and Born's Theory of Collisions. E. J. Williams. *Roy. Soc., Proc.* 135. *pp.* 108–131, *Feb.* 1, 1932.—The non-relativity theory of the passage of electric particles through matter developed by Bethe on the basis of Born's theory of collisions is compared with experimental results for the stopping-power, primary ionisation, total ionisation, straggling and production of branches by α- and β-particles. Some of these phenomena, which have long resisted a quantitative theoretical explanation [see Abstracts 1942 and 1943 (1931)], are found to be accounted for by the new theory. The experimental results for fast β-particles are discussed and indicate fairly definitely the necessity for a small relativity correction. The paper concludes with an extension of the results obtained for the relativity effect to high energy β-particles, such as those associated with penetrating radiation. H. H. Ho.

2466. Loss of Energy of α-Particles and H-Particles. P. M. S. Blackett. *Roy. Soc., Proc.* 135. *pp.* 132–142, *Feb.* 1, 1932.—The observed variation of velocity of an α-particle along its range in hydrogen, helium and air is compared with the theoretical expression given by Bethe's theory [see Abstract 3811 (1930)] of the loss of energy by fast particles. The difference between the velocity-range curves for slow α-particles and H-particles is shown to be probably due mainly to the effect of the capture and loss of electrons by the α-particle. A curve is constructed in a semi-empirical manner to represent the variation of the velocity of an H-particle in hydrogen along the whole of its range. An expression of the theoretical form, but with empirically determined constants, is used to extrapolate the α-particle range-velocity curves to give the ranges of fast H-particles. The values so obtained agree well with the few measurements available.

H. H. Ho.

2467. Range and Ionising Power of H′- and α-Rays. E. Rüchardt. *Ann. d. Physik*, 12. 5. *pp.* 600–606, *Feb.* 5, 1932.—The work of Gerthsen [see Abstract 3815 (1930)] on hydrogen canal rays is discussed in relation to earlier work on α-rays by Blackett [see Abstract 2211 (1923)] and it is shown that the results and conclusions of Gerthsen are in good agreement with Blackett's measurements. Gerthsen has shown that his range measurements are well represented by the formula $R = cv^{3/2}$. Blackett and Champion [see Abstract 1941 (1931)] find the same result for slow α-rays, but there is a departure from the law at the higher velocities, the exponent here going from 1·5 up to 2 and 3, again in agreement with Gerthsen's expectations. Calculations of the ionising power of α-rays from the results of Gerthsen for hydrogen canal rays are shown to give values greater than those obtained by Henderson, but less than those obtained by Schmidt and Stetter [see Abstract 178 (1931)]. A. W.

2468. Absorption of β-Rays. G. Fournier and M. Guillot. *Comptes Rendus*, 194. *pp.* 171–173, *Jan.* 11, 1932.—In a preceding paper [see Abstract 2333 (1931)] is developed a formula $\mu/\rho = 15 + 0{\cdot}142\,N$, where μ/ρ is the mass absorption coefficient of β-rays from Ra(D + E) in a metallic substance of atomic number N. Values are now obtained experimentally for μ/ρ for Li, Be, Ti and Zr, which fit the above formula. μ/ρ for the metalloids diamond and crystallised silicon do not fit the relation. Compounds are studied in the form of crystal powders; the following fit the formula, assuming an additive law: NaF, NaCl, KCl, AgCl, KBr, AgBr, KI, MgO, CuO. The following give mass absorptive coefficients markedly greater than the calculated values: SiC, Cu_2O, ZnS (two kinds), ZnO, AgI. It is pointed out that the second group contains compounds which have non-polar linkages, while the first group have polar linkages, and the similarity of the evidence provided by the Raman effect is mentioned.

A. C. M.

2469. Emission of High-Velocity Protons by the Action of Very Penetrating γ-Rays on Substances containing Hydrogen. Irène Curie and F. Joliot. *Comptes Rendus*, 194. *pp.* 273–275, *Jan.* 18, 1932.—The γ-radiation produced by the action of α-rays from polonium on beryllium or boron [see Abstract 1659 (1932)] after passage through a thin sheet of aluminium and 1·5 cm. of lead, is little affected by a further passage through thin screens of C, Al, Cu, Ag, Pb, etc.; but if passed through a substance containing hydrogen, *e.g.*, paraffin, water, etc., it produces greatly increased ionisation, up to double. The radiation to which this is due is completely absorbed by 2 mm. of aluminium, and its intensity is proportional to that of the original γ-radiation. It is due to H-particles, of paths in air respectively 26 and 8 cm. for those produced from beryllium and boron, and corresponding with energies of $4\cdot5$ and 2×10^6 electron-volts. It is suggested that the photons communicate part of their energy to the protons by a sort of Compton effect; also that other very penetrating radiation, *e.g.*, cosmic, should act similarly. No such effect is obtainable with thorium-C″. [See following Abstract.] C. A. S.

2470. Effect of Absorption of γ-Rays of Very High Frequency by Projection of Light Nuclei. Irène Curie and F. Joliot. *Comptes Rendus*, 194. *pp.* 708–711, *Feb.* 22, 1932.—The H-particles ejected from paraffin by γ-rays of polonium + Be [see preceding Abstract] when examined in a Wilson expansion chamber, show tracks of all lengths up to more than 12 cm., and also β-rays, some of which have energy more than 10^6 volts, which are probably due to a Compton effect. Comparison of the mass absorption coefficient of these γ-rays with that of γ-rays from ThC″ in Cu, C, and paraffin shows that much energy is absorbed by the H-nuclei, and a considerable amount by C; further, the ionisation current produced by the polonium + Be γ-rays in He is $4\cdot6$ times that produced in air at the same pressure. The phenomenon thus appears to be general. From considerations of the absorption by diffusion it is concluded that the absorption attributable to emission of H-particles is a new method of interaction between radiation and matter, for which the symbol J is proposed. The total absorption A_μ, by an atom of atomic number Z, consists therefore of the photoelectric effect A_τ, diffusion due to the Compton effect $Z\sigma_e$, J and (probably) K, connected with nuclear diffusion. Deduction of wavelength from the coefficient of absorption in cases of high quantum energies is thus erroneous. **Errata,** *ibid.*, p. 1032, March 14, 1932. [See following Abstract.] C. A. S.

2471. Ejection of Atoms by Very Penetrating Radiation Excited in Light Atoms. Irène Curie and F. Joliot. *Comptes Rendus*, 194. *pp.* 876–877, *March* 7, 1932.—Several photographs of the tracks of protons and helium nuclei referred to previously [see two preceding Abstracts] are here reproduced. They show that the ejections are not due to impact of anything that causes ionisation along its path. C. A. S.

2472. Ejection of Light Nuclei by Very Penetrating Radiation. Paths Photographed in a Wilson Chamber. P. Auger. Note by M. de Broglie. *Comptes Rendus*, 194. *pp.* 877–880, *March* 7, 1932.—The effects produced by the penetrating radiation emitted by beryllium under the influence of polonium have been examined in a strong magnetic field by means of a Wilson chamber. With moist air in the chamber electronic tracks were obtained arising from the impact of the radiation on the wall; these indicate potentials up to $6\cdot5 \times 10^6$ volts, and are possibly due to Compton effect. With a moist mixture of hydrogen and argon (3 : 1) in the chamber the tracks originated in the gas, and are due to protons of energies of from 50,000 to several million e.v. They are projected at all angles less than 90°, and with no apparent connection between velocity and direction of projection. It is suggested that there are two types of radiation: one electromagnetic and causing the Compton effect, the other the neutrons suggested by Chadwick [see following Abstract] which eject the protons [see three preceding Abstracts]. M. de Broglie obtained similar results by the action of α-particles from radium on beryllium, the γ-rays being filtered out by a lead screen. The number of particles observed by means of an ionisation chamber was trebled by placing paraffin at the entrance. The results were similar whether the chamber was constructed of Al, Zn, Cu or Pt. **Erratum,** *ibid., p.* 1111, March 21, 1932. C. A. S.

2473. Possible Existence of a Neutron. J. Chadwick. *Nature,* 129. *p.* 312, *Feb.* 27, 1932.—The author has made some experiments with the recently discovered radiations emitted by beryllium when bombarded by α-particles of polonium. Using a valve counter, the radiation has been shown to eject particles from H, He, Li, Be, C, A and air. The particles ejected from H behave like protons, and those from the others appear to be recoil atoms. Some of the recoil atoms in N produce at least 30,000 ions and have ranges at N.T.P. up to 3 mm. These values are far greater than those expected from quantum considerations such as are applied to the Compton effect. These and other difficulties disappear if the radiations from Be are assumed to consist of particles of mass 1 and charge 0, *i.e.,* to be neutrons. Further consequences of this hypothesis are discussed. It seems that the quantum view of the radiations can only be upheld if the laws of conservation of energy and momentum are relinquished at some point. [See four preceding Abstracts.] N. D.

2474. Disintegration Particle and γ-Radiation. P. Wright. *Cambridge Phil. Soc., Proc.* 28. *pp.* 128–135, *Jan.,* 1932.—An experiment by Jacobsen indicates that a γ-ray transformation of period comparable with that of RaC′ precedes the expulsion of α-particles. It is shown that from Jacobsen's results part of the γ-radiation from a source of recoil atoms should originate in the space surrounding the source. The γ-rays above the source should be detectable by ordinary methods and a description is given of an ionisation method capable of detecting the effect. The γ-rays predicted by Jacobsen's experiment were sought for with specially prepared sources of radium C. Phenomena associated with a recoil were also investigated for sources of Ra(B + C) and Th(B + C). No evidence of a γ-ray emission from the space above any of the sources was obtained. The negative result indicates that the interval between the departure of the disintegration particle and the emission of the γ-ray quantum is considerably less than 10^{-5} sec. J. J. S.

2475. Abnormal Absorption of Heavy Elements for Hard γ-Rays. C. Y. Chao. *Roy. Soc., Proc.* 135. *pp.* 206–213, *Feb.* 1, 1932.—A continuous range of wave-lengths for hard γ-rays has been secured, by using the rays scattered at different angles when a beam of the homogeneous γ-rays from ThC″ falls on a light scatterer, such as aluminium or magnesium. This gives a range of values from 4·7 to 4·7 + 48·5 X.U. The absorption coefficient of heavy elements can be measured for different wave-lengths within this range, and if a sharp excitation or disintegration potential exists for the particular heavy element investigated, it will be indicated by a sudden change in the nuclear absorption at a certain wave-length. The extra absorption of the scattered rays in lead was determined as the difference between the absorption per extra nuclear electron in lead and in a light element. In this way a rapid decrease of the extra absorption of lead was found between $\lambda = 5 \cdot 9$ and $6 \cdot 6$ X.U. This may be connected with the excitation or disintegration of the lead nucleus. H. N. A.

HEAT.

2476. Problem of Cooling. N. Gunther. *Comptes Rendus*, 194. *pp.* 538–541, *Feb.* 8, 1932.—A mathematical paper in which summation functions are obtained to satisfy certain conditions over a defined area. R. S. R.

2477. Rate of Heating in a Non-Heat-Insulated Metallic Bar. Speed of Propagation. P. Vernotte. *Comptes Rendus*, 194. *pp.* 541–544, *Feb.* 8, 1932.—Starting from the equation $\frac{\partial^2 V}{\partial x^2} = \frac{V}{\beta^2} + \frac{1}{a^2} \cdot \frac{\partial V}{\partial t}$, where $\beta^2 = \frac{4h}{kD}$ and $a^2 = k/c_p$, V being the temperature at a distance x from the origin, k the coefficient of thermal conductivity, c_p the specific heat of unit volume, D the diameter of the bar and h the coefficient of interchange between the bar and the surrounding air, heat is then applied at one end. For a bar of finite length the distribution of $\frac{\partial V}{dt}$ is obtained as a constant by a Fourier series or in a simplified form. These equations are discussed, and approximate values are obtained for the mean and instantaneous speed at points distant from the origin. R. S. R.

2478. Exchange of Energy between Atoms and Solid Surfaces. Part II. Temperature Variation of the Accommodation Coefficient of Helium. J. K. Roberts. *Roy. Soc., Proc.* 135. *pp.* 192–205, *Feb.* 1, 1932.—The apparatus used was similar to that of the author's earlier experiments [see Abstract 893 (1931)], but in order that the glass metal seals should stand immersion in liquid nitrogen the experimental tube was made of pyrex glass. The accommodation coefficient of helium with a clean tungsten surface has been found in the present investigation for temperatures between 22° C. and − 194° C. The value at the first of these temperatures was 0·057, which agrees with those obtained in Part I, which lay between 0·05 and 0·07. For 79° K. (− 194° C.) the extraordinarily low value 0·025 was obtained. The results indicate that if the observed variation continued down to the absolute zero the accommodation coefficient would approach zero. Effects due to adsorption and condensation of helium would make it impossible in practice to realise the lower part of the curve. H. N. A.

2479. Determination of the Stefan-Boltzmann Radiation Constant using a Callendar Radio-Balance. F. E. Hoare. *Phil. Mag.* 13. *pp.* 380–392, *Feb.*, 1932. *Supplement.*—A former paper [see Abstract 559 (1929)] gave details of a determination of the Stefan-Boltzmann radiation constant, the source of radiation being an electric furnace at temperatures 716·5° and 981·5° C. The present paper describes an extension to a source temperature of approximately 100° C., a Callendar radio-balance being employed to receive and measure the radiation. The mean of 50 measurements gives the value of the constant as $5 \cdot 737 \times 10^{-5}$ erg/sec./cm.^{2}/deg.^{4}, in good agreement with the former determination. T. B.

2480. Heating of a Thermometer by a Gas Stream. E. Brun and P. Vernotte. *Comptes Rendus*, 194. *pp.* 594–596, *Feb.* 15, 1932.—Describes experiments to determine the heating effect on a thermocouple due to a stream of air of high velocity. It was found that when the velocity was 80 m. per sec. the rise of temperature produced was 2·7°. By theoretical reasoning the authors find that this rise should be equal to $\frac{1}{4}V^2\eta/k = V^2/2Bc$, where V is the velocity of the gas stream, η is the viscosity, k the conductivity (in mechanical units), c the specific heat at constant volume and B a numerical coefficient which is about 1·9 for air. This formula gives 2·3° for the rise of temperature, a satisfactory agreement with the observed value. The authors conclude that the method may be applied to determine directly the frictional resistance of a body when travelling through air. J. W. T. W.

2481. Radiation Thermopiles. J. Strong. *Rev. Sci. Instruments*, 3. *pp.* 65–70, *Feb.*, 1932.—The sensitiveness of a thermopile depends upon the rate R of loss of heat by re-radiation and the loss of heat by conduction along the thermocouple wires. If O is radiation per sq. cm. of receiver per degree per second, it is shown that this constant plays a very important rôle in thermopile design, for R = AO/N, where A is area of receivers and N their number. A design of thermopile is described in which (1) two junctions give maximum sensitivity, (2) junctions may be welded in position by a condenser discharge, and (3) the receiver may be blackened by successive applications of blackener and tested for optimum thickness. It also possesses compactness of construction and freedom from drift. It is meant for use in a vacuum spectrograph, but may be equipped and sealed so as to be used with a separate vacuum system. T. B.

2482. New Type of Radiometer. A. L. M. Dingee. *Rev. Sci. Instruments*, 3. *pp.* 80–84, *Feb.*, 1932.—A condenser has been designed the capacity of which changes when the light intensity falling on it varies. The condenser plate on which the radiation falls is a thin blackened metal diaphragm, the linear expansion of which under the effect of impinging radiation causes it to bow out away from the other parallel plate. If p is the increase in separation of the plates, r, a and t the radius of curvature, coefficient of linear expansion and temperature-rise of the front plate respectively, it is shown that approximately $p = r.a.t.$ The capacity of a condenser being an inverse linear function of the separation between its plates, and the temperature-rise of a thin strip being nearly proportional to the radiation intensity falling upon it, it follows that the capacity varies inversely with the radiation intensity. For high frequencies this is found to be the case for a radiometer constructed by the author, employing the condenser as its light sensitive element. Methods of increasing the sensitivity of the radiometer and the applicability of the device to the measurement of line spectra intensities are discussed. T. B.

2483. Two Different Liquid States. M. Wolfke and J. Mazur. *Zeits. f. Physik*, 74. 1–2. *pp.* 110–127, *Jan.* 22, 1932.—Nitrobenzol, ethyl ether and carbon disulphide at critical temperatures exchange their physical properties for others while retaining a liquid form. They are thus analogous to liquid helium, which has two liquid forms, " liquid helium I " and " liquid helium II." A. D.

2484. Sensitive Flexible Thermostat. J. R. Roebuck. *Rev. Sci. Instruments*, 3. *pp.* 93–100, *Feb.*, 1932.—The scheme is to utilise the temperature-change of resistance of one or two coils of wire in order to unbalance a Wheatstone bridge whose galvanometer controls the heating current by means of a photoelectric cell and valve current amplifier.

The resistance coils are of pure nickel, which has a high temperature coefficient of resistance and responds quickly. The wiring diagram for the whole arrangement is shown diagrammatically. The apparatus is being used to control the temperature set anywhere between $-190°$ and $+300°$ C. For the low temperature it is of course necessary to supply cooling, which is adjusted by an automatically-controlled heating current. T. B.

2485. Hydrogen Liquefaction Plant at the Royal Society Mond Laboratory. P. Kapitza and J. D. Cockcroft. *Nature,* 129. *pp.* 224–226, *Feb.* 13, 1932.—A description of the cryogenic plant being installed in the Mond Laboratory for the liquefaction of hydrogen. This plant is capable of running on hydrogen of ordinary commercial purity, without blocking the exchanger tubes with solidified impurities. This result is achieved by using a small sample of purified liquid hydrogen to cool the commercial hydrogen at a pressure of 3 or 4 atmospheres. At this pressure the liquefaction point is higher than that of the pure hydrogen (at lower pressure), and thus the commercial hydrogen is liquefied. This part of the operation is carried out in a special cooler so arranged that the impurities can settle out and not block the tube. The pure hydrogen returns from the cooler to the throttle, where it is again liquefied and used again to cool further supplies of commercial hydrogen. The plant liquefies about 4 litres an hour, about 20 % being lost when the product is withdrawn to the Dewar vessel. Safety precautions are also described. J. H. A.

2486. Melting Point of Iridium. H. v. Wartenberg, H. Werth and H. J. Reusch. *Zeits. f. Elektrochem.* 38. *p.* 50, *Feb.,* 1932.—The value of the melting point hitherto accepted is 2350° or 2360° C. Since the purity of the iridium used for these determinations was in doubt, the authors have made a number of new determinations spread over a year. They have used samples of the metal purified by the methods of both Heraeus and L. Wohler; and 50 determinations gave respectively 2435 ± 15° C. and 2440 ± 15° C., referred to C_2 of Wien's law taken as 14320. It was found that small quantities of ruthenium or osmium considerably raised the melting point, 2 % of those metals increasing it by 200° C. Pieces of the purified iridium were suspended in a ZrO_2 tube oven and the rods observed by means of a platinum-rhodium mirror connected with a micro-pyrometer, the reading of which was taken just as the rods began to melt together with globules. Two observers worked together. To check the accuracy of the arrangement the melting point of platinum was measured and found to agree precisely with the standard value of 1770° C. T. B.

2487. Energy Content of Lead near the Supraconductivity Transition Point. K. Mendelssohn and F. Simon. *Zeits. f. phys. Chem.* 16. *Abt.B.* 1. *pp.* 72–76, *Feb.,* 1932.—Possible discontinuities in the energy content of metallic lead in the neighbourhood of the point at which the element becomes supraconducting, would be revealed by a change in the specific heat. Determinations of this constant have shown no such change, and more sensitive experiments also fail to reveal it. These experiments were designed, not to measure the specific heat, but merely to ascertain the form of its dependence on temperature. The method would certainly have shown any change as great as 0·01 cal./mol. (3 % of the specific heat). J. H. A.

2488. Adiabatic Microcalorimeter to Determine Specific Heat of Solids and Liquids. W. Swietoslawski, M. Rybicka and W. Solodkowska. *Acad. Polonaise Sci. et Lettres, Bull. No.* 4–5*A. pp.* 322–335, *April–May*, 1931. *In French.*—Corrections for the heat necessary to heat the contained gas, for loss or gain of heat due to adsorption or vaporisation of water (or other liquid) by or from the walls of the apparatus, and for variation in the surrounding temperature, are deduced for the author's adiabatic calorimeter [see Abstract 389 (1928)], and a modified form described. This consists of the microcalorimeter proper, which is placed in a spherical glass or copper vessel, and the whole in a large receptacle filled with water maintained at constant temperature. The substance is heated electrically at a rate of 0·25–0·45° per hr. For determining specific heats two such calorimeters are used, one of silver or copper of known heat capacity, the other similar and containing the liquid under examination for liquids, but made of the metal concerned for a metal. Determined in this way the specific heat at 17° of aluminium is 0·214, of pyridine 0·409. (See following Abstract.] C. A. S.

2489. Measurement of Heats of Adsorption and Vaporisation with Adiabatic Calorimeter. W. Swietoslawski and (Miss) E. Bartoszewicz. *Acad. Polonaise Sci. et Lettres, Bull. No.* 4–5*A. pp.* 336–347, *April–May*, 1931. *In French.*—To avoid the effect of variations in the surrounding temperature the galvanometer and commutator are placed in the receptacle filled with water. With this and other modifications (fully described) the adiabatic microcalorimeter [see preceding Abstract] is used for determining heats of adsorption and vaporisation with only a few cgm. of liquid. The heats of vaporisation of H_2O, C_6H_6 and $CHCl_3$ thus determined are 581, 98·2 and 66·8 cal. (± 0·3 %); the molecular heats of adsorption on charcoal (prepared by the action of $ZnCl_2$ on wood) of C_6H_6, EtOH and CCl_4 are 14·4, 15·6, and 15·8 cal./mol. (± 0·6–1·7 %) respectively, all at 20°. C. A. S.

2490. Heat of Vaporisation of Fatty Alcohols. (Miss) E. Bartoszewicz. *Acad. Polonaise Sci. et Lettres, Bull. No.* 4–5*A. pp.* 348–351, *April–May*, 1931. *In French.*—Using the apparatus previously described [see preceding Abstracts] the heats of vaporisation at 20° per gm., and per gm.-mol., are respectively: of MeOH 9·19, 287·0; EtOH 10·33, 224·3; PrOH 10·81, 180·1; $\mathrm{Pr}_{\beta}\mathrm{OH}$ 10·56, 175·8; BuOH 11·08, 149·5; $\mathrm{Bu}_{\beta}\mathrm{OH}$ 10·90, 147·2; all correct to ± 0·5 %. C. A. S.

2491. " Cooling Effect " of a Hot-Air Stream on a Water Surface. A. W. Scott. *Roy. Techn. Coll. Glasgow, J.* 2. *pp.* 620–629, *Jan.*, 1932.—When a water surface is exposed directly to a hot-air stream, the water temperature may fall, remain steady, or it may rise, the governing factors being the air and water temperatures and the air humidity. An experimental investigation of the effect of these factors is described. The results are incorporated in the laws of evaporation and heat transfer, and physical constants are provided which enable the effect on the water temperature to be estimated for any given conditions. The application to spray drying of milk is specially considered. AUTHOR.

2492. Theory of the Psychrometer. M. Robitzsch. *Zeits. f. Instrumentenk.* 52. *pp.* 80–85, *Feb.*, 1932.—The internal energy (from a suitable arbitrary zero) of moist air is the sum of the energy $T . c_p$, due to the dry air itself, and L*s*, due to the moisture present, where T is the

absolute temperature, and c_p the specific heat of dry air, L the latent heat of evaporation of water and s the mass of water in unit volume of the moist air. Now s is proportional to the vapour pressure e and inversely proportional to the barometric height B. Substituting for the numerically known quantities, the internal energy is $c_p(T + 1570e/B)$. The second factor is called θ, the equivalent absolute temperature. The author asserts that the heat loss from a moist surface is proportional to the difference between θ at the surface, and θ for the ambient air, and on this basis he derives the well-known formula, known usually by the name of Sprung, for the wet- and dry-bulb hygrometer. This theory would make the wet-bulb depression independent of air velocity, but, by considering the effect of radiation, it is shown that actually the constant A decreases with increasing air velocity, in qualitative agreement with experiment.
J. H. A.

2493. Law of the Wet- and Dry-Bulb Hygrometer from 40° to 100° C. J. H. Awbery and E. Griffiths. *Engineering*, 133. *pp.* 113–115, *Jan.* 22, 1932. *Abstract of Paper read before British Assoc., Sept.*, 1931.—The wet-bulb depression, for dry-bulb temperatures from 40° to 100° C. and for a range of humidities, has been directly measured, and the results expressed in the form of a skeleton set of "wet- and dry-bulb" tables. The humidities were obtained by the dew-point and also by the gravimetric method (absorption in H_2SO_4). Special precautions were necessary to operate the dew-point instrument at these temperatures, and in a rapid air stream. See also *Phys. Soc., Proc.* 44. pp. 132–141; *Disc.*, 141–142, March 1, 1932.
J. H. A.

2494. Electrical Method of Determining the Dew Point, applicable to Thermal Machines. P. le Rolland and T. T. Lou. *Comptes Rendus*, 194. *pp.* 258–260, *Jan.* 18, 1932.—The method depends on the fact that an insulating surface becomes conducting when dew is deposited thereon, the resistance being of the order of 100 megohms/mm. Two electrodes touching such a surface are connected with an arrangement which either works a telephone or illumines a neon tube when the surface becomes conducting. The method is also applicable to the determination of the pressure of water vapour in any gaseous mixture.
C. A. S.

2495. Condensation Diagram. P. I. Dee. *Cambridge Phil. Soc., Proc.* 28. *pp.* 93–98, *Jan.*, 1932.—A chart from which the amount of water condensed can be read off, when air at a temperature t_1 is adiabatically expanded from volume v_1 to v_2, and then allowed to assume equilibrium. It is also possible to obtain the equilibrium temperature from the same chart.
J. H. A.

2496. Vapour Pressure of Water over Solutions of Alkaline-Earth Chlorides. J. R. I. Hepburn. *Chem. Soc. J. pp.* 550–582, *Feb.*, 1932.—The matter is dealt with in three papers. In the first, the experimental results are given. The vapour pressures are measured by the dew-point method developed by the author, the results being partially checked by comparison with independent data on solutions of potassium chloride. The results given cover the range from a molality of 0·200 up to saturation, for each of the salts $CaCl_2$, $SrCl_2$, $BaCl_2$, all at a temperature of 25° C. They are given to an accuracy of 0·01 mm. of mercury, and are compared with the data of previous observers. The second paper discusses the results in the light of the van t'Hoff coefficients, which are found to pass through a minimum at a concentration in the neighbourhood of 0·3 molality. This minimum has also been found by other workers who covered this concentration range and worked with sufficient accuracy to disclose the effect. The concentration at which the minimum occurs appears to vary with temperature. There is also a maximum in the neighbourhood of M = 5 to 6. The third paper deals with the correlation between the vapour-pressure results and the data on freezing-point lowering, viscosity, heat of dilution and specific gravity. The last-mentioned does not show the anomalies, but all the other properties show minima in their appropriate coefficients, at approximately the same concentration. J. H. A.

2497. Vapour Pressures of Binary Mixtures. A. W. Porter. *Faraday Soc., Trans.* 28. *pp.* 95–97, *Feb.*, 1932.—Previous work by the author on the vapour pressures of binary mixtures involved the use of a simple form of the Duhem-Margules equation according to which $\log \pi_1/\Pi_1\mu_1 = \beta\mu_2^2$, where μ_1, μ_2 are the molar fractions of the two components, π_1 and Π_1 the vapour pressures for the solution and the pure state. Recently Bancroft and his co-workers have submitted approximate formulæ in various forms, one of which is equivalent to $\pi_1/\Pi_1 = \mu_1^a$, this giving values for the vapour pressures, if appropriate values of *a* are chosen, which are very similar to those afforded by the first formula above. Both formulæ are now found to be included in the form:

$$y = \log_e \pi_1/\Pi_1\mu_1 = (a - 1)\log_e \mu_1 + \beta\mu_2^2,$$

which is discussed for the mixtures acetone-ether and alcohol-water. H. H. Ho.

2498. Isothermal Measurements with Hydrogen between 0°–100° C. and up to 1000 Atmospheres. A. Michels, G. P. Nijhoff and A. J. J. Gerver. *Ann. d. Physik*, 12. 5. *pp.* 542–568, *Feb.* 5, 1932. —Using a method previously described [see Abstract 877 (1929)] the pressure and density of hydrogen are measured up to 1000 atmospheres pressure at temperatures near 0°, 25°, 50°, 75° and 100° C. respectively. Values at intermediate temperatures and pressures are calculated, using special methods of interpolation. Virial coefficients are calculated by the method of Onnes. N. D.

2499. Van der Waals' Equation for the Inert Gases. E. Neusser. *Phys. Zeits.* 33. *pp.* 76–81, *Jan.* 15, 1932.—A continuation of previous work [see Abstract 1601 (1931)]. The constants *a* and *b* in van der Waals' equation are determined from experimental results as functions of pressure and temperature for the gases argon, helium and neon. In addition, the atomic weights are calculated and also a value for the ice point on the thermodynamic scale, *viz.*, 273·207 ± 0·007°. At higher temperatures, *a* and *b* are independent of pressure, and decrease irregularly with increasing temperature, until *a* practically vanishes. J. H. A.

2500. Quantum Dynamical Correction for the Equation of State of Real Gases. H. Margenau. *Nat. Acad. Sci., Proc.* 18. *pp.* 56–62, *Jan., and p.* 230, *March*, 1932.—Calculates the second virial coefficients for gases, taking account of the zero-point energy associated with vibratory motion in quantised collision states. J. H. A.

SOUND.

2501. Sound Absorption Measurement. R. F. Norris. *Acoustical Soc. of America, J.* 3. *pp.* 361–370, *Jan.*, 1932.—Describes a method of measuring the sound absorption coefficients of materials using a small sample of area 16 sq. ft. The sample is put in a small chamber, 5 × 6 × 9 ft., which contains a large rotating mixing-paddle, 4½ × 5½ ft., and the small reverberation period of which is readily measured by the Norris–Andree method. Only a small sample and a small test chamber are necessary and no reference material is needed against which the unknown may be calibrated. The computation is simple and quick.

W. H. Ge.

2502. Apparent Reduction of Loudness. D. A. Laird, E. Taylor and H. H. Wille, Jr. *Acoustical Soc. of America, J.* 3. *pp.* 393–401, *Jan.*, 1932.—Observers with normal but untrained hearing were given a buzz from an audiometer for 3 sec. After an interval of 3 sec. a less intense buzz was given for another 3 sec. and was adjusted till it was repeatedly judged to be " half as loud " as the original. A level of 80 db appears to be halved when reduced to 60 db, and 60 db doubled by 79 db or halved by 41. In similar experiments consistent results were obtained under various conditions. The effect is not due to memory-fading and it did not vary much with the individual. W. H. Ge.

2503. Transmission of Sound through Apertures. E. Ritchie. *Acoustical Soc. of America, J.* 3. *pp.* 402–414, *Jan.*, 1932.—Experimental measurements have confirmed Lamb's theoretical treatment of the problem concerning the fraction of sound transmitted by an aperture in a very thin plate. Measurements were made for thick plates where the diameter of the hole exceeds the length and also for plates containing several holes. The transmission for apertures of various sizes and lengths was found to be directly proportional to the area of the apertures. W. H. Ge.

2504. Determination of Absorption Coefficients for Frequencies up to 8000 ∼. F. L. Hopper. *Acoustical Soc. of America, J.* 3. *pp.* 415–427, *Jan.*, 1932.—The chamber reverberation method was employed to determine the absorption characteristics of a variety of acoustic materials for frequencies up to 8000 ∼. Details are given of the reverberation and transmission chambers and also of the measuring equipment, which consists of a condenser transmitter and its associated amplifier and an electrical reverberation time-meter. A recording level indicator is provided for use in transmission measurements and may be connected to the microphones in either the transmission or reverberation rooms. Since the absorption of sound in air is an important factor in the determination of absorption coefficients for the higher frequencies by the reverberation method, and since this absorption is a function of both frequency and humidity, a careful technique of measurement is essential to secure accurate results for frequencies above 1000 ∼. Such a technique is described and results are given for a number of different materials.

A. W.

2505. Transmission of Sound through Sea Water. H. G. Dorsey. *Acoustical Soc. of America, J.* 3. *pp.* 428–442, *Jan.*, 1932.—An interesting paper discussing observational results obtained by ships of the U.S. Coast and Geodetic Survey in the operation of the fathometer and in determining the ship's position by the radio-acoustic method, using two hydrophones located in known positions, each hydrophone being arranged to operate a radio transmitter whenever a sound of sufficient intensity reaches it. The difficulties encountered and due to the Gulf Stream are discussed at some length. The main points brought out in the paper are as follows: The hypothesis of the transmission of sound through sea water by multiple reflection does not seem justifiable. Instead, a hypothesis is proposed in which the method of transmission would not be far different from that for air. The ordinary laws of reflection apply. The velocity of sound is greater in warm water than in cold. The acoustic resistance of sea water is greater when warm than when cold. The time of travel of a subaqueous sound from one point to another is, in general, not a single definite quantity, but may be a series of values of relatively considerable length. The measured time of travel depends upon the measuring apparatus, being less for more sensitive instruments. In the radio-acoustic method of determining ranges the peak of sound energy which operates the radio signal may not be the first to arrive. The velocity of transmission is independent of the intensity of the signal, but recording instruments may give erroneous values. A. W.

2506. Pressure Equalisation Phenomena in Tubes. H. Schardin. *Phys. Zeits.* 33. *pp.* 60–64, *Jan.* 15, 1932.—Equations are derived applicable to the case of a tube in which an equalisation of two different pressures follows the sudden opening of a valve. A table is given of the values of velocity, pressure and temperature calculated for the resulting wave at a series of points along the tube. This table explains the existence of a maximum of the sound produced, as well as the occurrence of temperatures so high that an explosion may occur. A. W.

2507. Pressure in Air-Shock Waves. W. Schneider. *Zeits. f. Physik,* 74. 1–2. *pp.* 66–87, *Jan.* 22, 1932.—In air-shock waves there are great and rapid changes of pressure. It is therefore hardly possible with a membrane apparatus to get a distortionless record of the pressure. The author presents a method of computing the pressures from distorted records by observing the divergences from a standard differential equation of motion and extrapolating. A. D.

2508. Velocity of Sound in the Stratosphere. B. Gutenberg. *Gerlands Beitr. z. Geophys.* 35. 1. *pp.* 46–50, 1932.—A reply to Whipple's criticisms [see Abstract 160 (1932)] of the author's method of calculating sound velocity in the stratosphere in connection with the zone of abnormal audibility [see Abstract 568 (1931)]. In so far as they are not due to misunderstanding, these criticisms only refer to points the effect of which lies within the limits of unavoidable errors due to the present unsatisfactory state of observed data. With more accurate data Whipple's much more laborious method will give more accurate results, and it would be worth while adopting it. C. A. S.

2509. Velocity of Sound in Carbon Dioxide. O. Hell. *Zeits. f. Physik,* 74. 1–2. *pp.* 31–33, *Jan.* 23, 1932.—The author, in a paper on extinction of fluorescence, and passage from resonance series spectra to band spectra [see Abstract 2402 (1932)], has shown that molecules do not alter their rotation and vibration greatly during collisions. This result seems at first sight to be contradicted by Kneser's work [see Abstract 1675

(1932)], which shows that the velocity of sound in CO_2 depends on the frequency. The author shows, however, by considering the way in which a CO_2 molecule can be set into vibration on collision, in view of the fact that its three atoms are arranged in a straight line, that only one CO_2 molecule in 10^6 can possibly supply sufficient energy to raise the vibrational energy by a vibrational quantum. This shows that Kneser's result is to be expected. H. N. A.

2510. Ultrasonic Velocity Measurements. C. R. Randall. *Bureau of Standards, J. of Research*, 8. *pp.* 79–99, *Jan.*, 1932.—A description is given of the ultrasonic interferometer apparatus and the method used in measuring ultrasonic velocities in liquids. The results of ultrasonic measurements on distilled water at temperatures 0° to 86° C. and on aqueous solutions of four kinds of sugar for several concentrations and a series of temperatures are presented in curves and tables. The compressibility of distilled water and of the solutions is determined from ultrasonic velocity measurements. Pyrex glass suspensions (aqueous) were prepared, the pyrex particles ranging in size from 2μ down. Ultrasonic velocity measurements were made on these suspensions for the purpose of testing the possibilities of a theory for getting the compressibility of a solid by a velocity-suspension method. The results obtained, though largely qualitative, show the possibilities and limitations of the method. AUTHOR.

2511. Ultrasonic Dispersion and Selective Absorption in Liquids. Part I. R. W. Boyle, D. K. Froman and G. S. Field. *Canad. J. of Research*, 6. *pp.* 102–118, *Jan.*, 1932.—An experimental study by the ultrasonic method of the phase velocity of longitudinal waves transmitted in liquids contained in tubes. Greatly augmented as well as largely decreased velocities may be obtained in any liquid by suitably adjusting the frequency of the wave or the diameter of the containing tube. This phenomenon, described here at length for the first time, is found to be caused by the selective absorption of energy of the longitudinal wave at certain frequencies, resulting in a velocity-frequency curve analogous to the " anomalous dispersion " curve of optics. In the experiments there is strong indication that the absorbing frequency depends inversely on the diameter of the tube. The fact that the absorption frequency does not depend on the material or length of the tube, or for thin walls on the wall thickness, indicates that it is neither longitudinal nor flexural (lateral) vibrations in the tube walls which cause the phenomenon: and the fact that for any liquid the critical frequency shifts with change of diameter indicates that it is in the column of liquid itself that the energy absorption or transference takes place. These experiments show that it is only at frequencies far removed from absorption, *i.e.*, on the regular and flat portions of the velocity-frequency curve some distance from the discontinuity, that the usual theories of sound transmission may safely be applied. [See following Abstract.] AUTHORS.

2512. Ultrasonic Dispersion and Selective Absorption in Liquids. Part II. G. S. Field and R. W. Boyle. *Canad. J. of Research*, 6. *pp.* 192–202, *Feb.*, 1932.—More experimental work has been done on the propagation of ultrasound along tubes filled with liquid. The mathematical theory developed by Field [see Abstract 4261 (1931)] has been subjected to a quantitative verification, and it has been shown that the discontinuities in the velocity-frequency curve are due to a transference of energy at certain frequencies from the longitudinal to a radial vibration. It has also been shown that the theory satisfactorily accounts for the observed facts, the phase velocities, particle velocities and the absorption frequencies having the values which the theory requires. [For Part I see preceding Abstract.] AUTHORS.

2513. Velocity of Ultrasonic Vibrations in Cylindrical Bars. K. Röhrich. *Zeits. f. Physik,* 73. 11–12. *pp.* 813–832, *Jan.* 15, 1932.—A formula is derived for the speed of longitudinal waves in bars allowing for effects due to friction, heat conduction and lateral motion. Using a quartz plate, stationary waves were produced in bars of steel, glass, copper, brass and aluminium, and the velocity was determined from measurements of frequency and wave-length. For longitudinal waves, the velocity decreases as the frequency increases, but the course of the change does not agree with theory. In the case of transverse waves the speed increases with the frequency. It was found impossible to obtain pure longitudinal waves alone. Whatever method of excitation was employed, all types of vibration appeared. G. E. A.

2514. Interferometer Method of Studying the Vibrations of an Oscillating Quartz Plate. H. Osterberg. *J.O.S.A.* 22. *pp.* 19–35, *Jan.,* 1932.—An expression involving the fringe brightness as a function of the amplitude of vibration is obtained for the case of a Michelson or a similar interferometer in which one of the returning mirrors executes S.H.M. in a direction perpendicular to its plane. A detailed discussion of the application of this expression to the measurement of the amplitude of vibration of a quartz plate is given, together with the observations upon four such plates. The superposition of either the first or second overtone upon the fundamental is also considered. The observed vibrations are predominantly flexural. The experimental results of Doerffler [see Abstract 215 (1930)] relating to the frequency dependence of the velocity of flexural waves are confirmed and found to apply to X-waves in a Y-cut. There is evidence of low frequency flexural waves propagated diagonally across a quartz plate. An interferometer method is suggested for distinguishing between flexural and longitudinal vibrations. AUTHOR.

2515. Vibrations of an Annular Plate of Variable Thickness. J. Ghosh. *Indian Phys. Math. J.* 3. *pp.* 61–64, *Jan.,* 1932.—An exact solution is obtained for the problem of transverse vibration of a thin annular plate whose half-thickness h is related to the distance r from the centre by the equation $h = ar^2$ (a being a small constant), and whose edges are concentric circles of radii a and b. The plate is clamped along both these edges. J. P. A.

2516. Sound Generated by a Rotating Airscrew. E. T. Paris. *Phil. Mag.* 13. *pp.* 99–111, *Jan.,* 1932.—The distribution of the fundamental sound of rotation round a two-bladed airscrew on a stationary aeroplane is measured experimentally, and the results are compared with those derived from the theories of Lynam and Webb and of Hart. The hypotheses of Lynam and Webb are shown to be untenable. Experiment shows that there is zero sound intensity along the axis of the airscrew, forwards and backwards, that there is a principal maximum in a direction about 25° behind the plane of rotation of the airscrew and a secondary maximum in front of this plane at about 30°–45° from the axis of rotation. The distribution of sound is not symmetrical about the axis, and the airscrew cannot be represented by a set of simple sources in the plane of rotation. By combining the hypotheses of Lynam and Webb, a formula has been derived which actually represents the principal observed features of sound distribution. N. D.

2517. Sensitive Flames. G. B. Brown. *Phil. Mag.* 13. *pp.* 161–195, *Jan.*, 1932.—Description of tests of sensitive flames including six forms of high pressure jets and three low pressure jets. These were investigated as to the effect of frequency on their sensitivity, and the variation of the response with the amplitude of the sound. Experiments were also made on air jets containing smoke. For jet diameters between 0·5 mm. and 0·5 cm. all streams show some sensitivity to sound. The position and construction of the tube supplying gas to the jet affect the sensitivity in so far as they influence the mode of outflow through the orifice. The frequencies producing maximum and minimum disturbance respectively are definite for a given gas, and do not vary with the kind of jet used. The range of frequency varies with the gas and the jet. With air it lies between 80 and 900, with unlit gas somewhat higher, and with ignited coal gas or hydrogen from 500 to 18,000. G. E. A.

2518. Non-Linear Distortions in Sound Films. A. Narath. *Zeits. f. techn. Physik*, 13. 1. *pp.* 17–31, 1932.—Calculates the non-linear distortions produced in the " blackening " or " rung " system of sound-recording, in which the photographic record is always of uniform intensity in a direction at right angles to the direction of travel of the film, due to the Kerr cell and the photographic process respectively. The " rasping factor " (*Klirrfaktor*) is defined as the ratio of the root mean square of the amplitude of the overtones to the fundamental amplitude. The non-linearity of the Kerr cell and that due to the photographic process may approximately compensate each other, in which case the Goldberg condition does not apply. E. E. F. d'A.

2519. Japanese Vowels. M. Takahashi and G. Yamamoto. *Electrot. Laborat. Tokyo, Japan, Researches, No.* 326. [23 *pp.*], *Oct.*, 1931.—The physical nature of some Japanese vowel sounds is studied by the aid of a condenser microphone (Wente type) and either an electrical frequency analyser or an oscillograph and mechanical harmonic analyser. The ordinary fundamental pitch of Japanese speech vowels is about 120–200 $\sim$ for the male and 200–300 $\sim$ for the female voice. The energy and characteristic frequency bands are studied. One vowel can be converted to another by passing the electrical current caused by it through a suitable filter circuit. There are 36 pages of illustrations. W. H. Ge.

2520. Tone Quality of Musical Instruments. E. Meyer and G. Buchmann. *Preuss. Akad. Wiss. Berlin, Ber.* 52. *pp.* 735–778, 1931.—A Wente type condenser microphone with suitable electrical amplification and a Moll microgalvanometer were used to explore the tone quality of many musical tones over a range of about 100–10,000 $\sim$. Records of all the instruments of the modern symphony orchestra, each for several notes in its compass, are reproduced in 60 diagrams giving the sound spectrum for each. W. H. Ge.

ELECTRICITY AND MAGNETISM.

ELECTROSTATICS, TERRESTRIAL ELECTRICITY AND MAGNETISM.

2521. Piezoelectricity. G. Greenwood and D. Tomboulian. *Zeits. f. Krist.* 81. 1–2. *pp.* 30–37, *Jan.*, 1932. *In English.*—A description is given of the application of an oscillating circuit device to the testing of crystals for piezoelectricity. Essentially the method consists of the oscillator-detector circuit of Hettich used in conjunction with a transformer-coupled amplifier. This circuit can be used to study crystals which are electrically conducting and a series of crystals was investigated. Picric acid and scolecite which are said to be pyroelectric showed no signs of being piezoelectric. The double salts of tartar emetic and certain metallic nitrates, barium antimonyl tartrate and strontium dimalate, said to belong to the orthorhombic bisphenoidal class, showed no piezoelectricity. The nitrates of Sr, Ba and Pb do not exhibit piezoelectricity and therefore probably belong to the dyakisdodecahedral class. Crystals of strontium chlorate, *p*-chloracetanilide, cinchonine, lead antimonyl tartrate, the double salt of tartar emetic and sodium chloride and chalcopyrite were found to be piezoelectric. J. J. S.

2522. Piezoelectric Peculiarities of Rochelle Salt Crystals. R. D. Schulwas-Sorokin. *Zeits. f. Physik,* 73. 9–10. *pp.* 700–706, *Jan.* 8, 1932.—The piezoelectric modulus of Rochelle salt was measured at various temperatures. Values were obtained which exceed ten times those hitherto obtained, but its behaviour as to temperature agrees qualitatively with that found by Valasek [see Abstract 1152 (1921)]. The value of the modulus at room-temperature and load of 1 kg./cm.^{2} amounts to $2\cdot 6 \times 10^{-4}$ e.s.u./dyne with a variation of about 15 % for various tests. The piezoelectric characteristics of Rochelle salt change with the load and in the temperature region $-16°$ to $+23°$ C. with 30 kg./cm.^{2} a saturation is attained. For other temperatures no saturation was observed. At the load of 50 kg./cm.^{2} the piezoelectric moment is the same for all temperatures. J. J. S.

2523. Properties of the Electret. T. Tiku. *Phys. Math. Soc., Japan, Proc.* 14. *pp.* 63–88, *Feb.*, 1932. *In English.*—On withdrawal of the electric field from the electret (a dielectric prepared from mixtures of equal parts of carnaüba wax and resin) after it had solidified, charges ϕ were found on the electrode. The charges were observed by the rising of the potential of the metal electrode which is placed in contact with the electret in order to produce an electric field, and which, upon solidification of the electret mixture, adhered firmly to it. The sign of the charges was the same as that of the electrode when the field was applied, and the relation $d\phi/dt = Ae^{a(T_0-T)}$ was found to hold good when the temperature of the electret was decreasing with time, where $d\phi/dt$ is the rate of accumulation of the charges, A and a are constants independent of the temperature, and T_0 and T are the initial and cooled temperatures respectively. An important factor influencing the amount $d\phi/dt$, is the extent to which the solidification of the electret mixture has proceeded before the electric field is withdrawn, and this was most pronounced when withdrawal was made before the mixture had turned very hard. It appears that two different kinds of charges are generated according to the state of the mixture. [See Abstract 2758 (1931).] H. H. Ho.

2524. Electric Discharge from Water Drops. J. J. Nolan and J. G. O'Keeffe. *Roy. Irish Acad., Proc.* 40. *pp.* 86–98, *Feb.*, 1932.—An electric field is applied between a hemispherical drop supported on a glass tube and a brass disc, 5 cm. in diameter, having its centre 1 cm. above the drop. For all drops the negative discharge begins at a lower potential difference than the positive, and the negative current always exceeds the positive. When rapid discharge sets in the uniform field F is connected with the radius r of the drop by the formula $F\sqrt{r} = 3 \cdot 6 \times 10^3$. The ions produced in the discharge from a water surface always remain small in pure air; there is no disintegration of the liquid surface of such a kind as to produce nuclei which could become larger ions by picking up the small ones which are present in large quantities. H. M. B.

2525. Effect of Radioactive Materials upon the Volta Effect. L. Bouchet. *Comptes Rendus*, 194. *pp.* 695–697, *Feb.* 22, 1932.—Uranium oxide is found to have very little effect, if any, upon the volta e.m.f. between metals. J. S. G. T.

2526. Effect of Electrolytes on the Dielectric Constant of Water. Parts III and IV. R. T. Lattey and W. G. Davies. *Phil. Mag.* 13. *pp.* 444–455, *Feb.*, 1932. *Supplement.*—The voltage tuning resonance method [see Abstract 1685 (1932)] is applied to the determination of the dielectric constants of solutions of various multivalent salts. For each salt there is an increase in dielectric constant with the concentration of the solution, such increase being linear except for $CuSO_4$ and $MgSO_4$, for which the rise in dielectric constant falls off from linearity with increasing concentration. For salts of 1 : 2 type, $CdBr_2$ and $Mg(NO_3)_2$ show increases of the same amount, but these are considerably less than the values for $BaCl_2$. The 1 : 3 and 1 : 4 salts have increases of the same amount within the limit of experimental error. The increase of dielectric constant with concentration is contrary to the results of recent investigations. Various hypotheses have been advanced to explain the decrease observed, but the results of different observers are in such great disagreement that no definite conclusions can be reached about any of the hypotheses. T. H. P.

2527. Dipole Moments of Acetophenone Derivatives. O. Hassel and E. Næshagen. *Zeits. f. phys. Chem.* 15. *Abt.B.* 6. *pp.* 417–420, *Feb.*, 1932.—The moments of *p*-chloro-, *p*-bromo- and *p*-iodo-acetophenone are experimentally determined to be $2 \cdot 29$, $2 \cdot 29$ and $2 \cdot 23 \times 10^{-18}$ e.s.u. respectively, whilst the moment of *p*-aminoacetophenone is $4 \cdot 3 \times 10^{-18}$. These results are discussed. H. H. Ho.

2528. Total Electric Polarisation and Electric Moments of Certain Organic Molecules. L. M. Heil. *Phys. Rev.* 39. *pp.* 666–674, *Feb.* 15, 1932.—An investigation has been made of the effect of temperature on the dielectric constants and densities of bromobenzene and iodobenzene in dilute solution with hexane, and of hexane and *m*-, *p*- and *o*-xylenes as pure liquids. The values obtained for the electric moments are as follows: *p*-xylene, 0; *m*-xylene, $0 \cdot 34 \times 10^{-18}$; *o*-xylene, $0 \cdot 44 \times 10^{-18}$; bromobenzene, $1 \cdot 35 \times 10^{-18}$; iodobenzene, $1 \cdot 25 \times 10^{-18}$. In every case it was found that the Debye law, $P = P_0 + a/T$ was valid. The results of this investigation give additional evidence of the rule that, as the atomic weight of a substituted atom is increased, the electric moment of the molecule decreases. Evidence is deduced which suggests that the induced polarisation may be a function of the temperature and that this effect may neutralise or diminish the effect of a small dipole. AUTHOR.

2529. Variation of the Surface Tension of Fulminating Matter as a Function of Temperature and Mass. E. Mathias. *Comptes Rendus,* 194. *pp.* 413–416, *Feb.* 1, 1932.—From considerations based on the theories of van der Waals and Clausius it is shown that in a mass of gas (fulminating matter) the surface tension is proportional to the square of the molecular mass and in inverse ratio to the cube of the absolute temperature. The fulminating matter has a density sensibly that of air, or a little greater, and the molecular mass is 10 times that of normal air, and its surface tension is, other things equal, 100 times greater than that of ordinary air at the same temperature. During the first portion of its fall (its temperature of formation being $T = 10 \times 273°$) its surface tension scarcely exceeds four times its initial value, but from temperature 1000° it assumes notable values and increases rapidly as the temperature falls. The results are compared with observation of a case of spherical lightning. It is only when the cooling is sufficiently great that the surface tension having acquired a suitable intensity is able to draw in the exterior surface of the fulminating matter so as to give it sensibly the minimum area.

J. J. S.

2530. Fundamentals of a Mathematical Theory of Cosmic Ray Coincidences in Counter Tubes. L. Tuwim. *Preuss. Akad. Wiss. Berlin, Ber.* 33. *pp.* 830–949, 1931.—The general problem here considered in great mathematical detail is the determination of the number of double or multiple cosmic ray coincidences in an arbitrary arrangement of counter tubes orientated in any direction and subject to the action of heterogeneous cosmic rays incident from a part or from the whole of the sky. By varying the geometrical parameters determining the counter-tube system and its orientation the complete character of the cosmic radiation is determinable. Using widely separated counter tubes a kind of cosmic ray telescope is obtained which enables the character of the cosmic radiation from a restricted region of the sky to be investigated. The specific " coincidence capacity " of a component of the cosmic radiation and its determination by the present methods are discussed in detail. W. S. S.

2531. Air-Pressure Coefficient of the Hard Ultra-Radiation. W. Messerschmidt and W. S. Pforte. *Zeits. f. Physik,* 73. 9–10. *pp.* 677–680, *Jan.* 8, 1932.—Exact measurements of the ultra-radiation have shown a dependence of the intensity of the radiation on the state of the barometer. The authors have carried on during half a year a registration of the ultra-radiation at Halle with apparatus previously described [see Abstract 890 (1931)]. From the results of these observations it was found that the air-pressure coefficient of the hard radiation (with screening on all sides by 10 cm. lead) is very constant as to its mean value during the six months' course of the experiments, as also is the intensity of the radiation reduced to 750 mm. on the barometer. With quickly passing depressions of the barometer deviations from the mean value of the air-pressure coefficient were observed. J. J. S.

2532. Diurnal Period in Ultra-Radiation. W. Messerschmidt. *Zeits. f. Physik,* 74. 3–4. *pp.* 187–190, *Feb.* 11, 1932. *Phys. Zeits.* 33. *pp.* 233–234, *March* 15, 1932.—A variation of intensity in the period of a solar day is found in the form of a double wave with unequal maxima. This cannot be a direct solar effect. Hoffmann's results are compared [see Abstract 3905 (1931)]. No effect in the period of a sidereal day can be found. T. L. M.

2533. Spectrum of Ultra-Radiation. Part I. E. Regener. *Zeits. f. Physik,* 74. 7–8. *pp.* 433–454, *Feb.* 23, 1932.—Measurements were made of the absorption of ultra-radiation to a depth of 230 m. in Lake Constance. The recording electrometer used is fully described; the accuracy of the measurements is considerably improved; readings are accurate to about 0·02 volt. Extensive details are given of the adjustment of the apparatus and of all the measurements carried out; the method of sinking the apparatus is illustrated; it was floated from an anchor fixed in the bottom and attached to a light buoy. The most penetrative part of the radiation is found to be sensibly homogeneous from 80 m. downward and has then, as computed for parallel incidence, an absorption coefficient of $1 \cdot 9 \times 10^{-4}$/cm. water. Its wave-length corresponds to the radiation of the mass of a He atom. T. L. M.

2534. Variation of Intensity of Cosmic Ultra-Radiation. F. Lindholm. *Gerlands Beitr. z. Geophys.* 35. 2. *pp.* 224–229, 1932.—Autographic records of cosmic ultra-radiation were made in Stockholm from Oct., 1930, to Feb., 1931. Individual series of measurements show very different pressure coefficients and in some cases a weak correlation between ionisation and pressure. There is a marked daily variation of ionisation with the afternoon maximum similar to that for Muottas Muraigl and a similar daily period after penetrating 10 cm. of Pb. The bearing of the measurements made by Hess and Steinmauer on a similar period for this radiation is discussed. The results for Stockholm and Muottas Muraigl when reduced to the same pressure show similar results for hard and unfiltered radiation. The daily period is very similar to that for atmospheric potential gradient, but the semidiurnal term does not show this so well. The values for the absorption coefficient and the mass absorption coefficient in lead for perpendicular incidence gives values of the same order of magnitude for Muottas Muraigl in summer and winter and for Stockholm in winter. R. S. R.

2535. Terrestrial Magnetic Field and Corpuscular Radiation. B. Rossi. *Accad. Lincei, Atti,* 15. *pp.* 62–69, *Jan.* 3, 1932.—Works out a calculation, simplified as far as may be, of the action of the terrestrial magnetic field upon a corpuscular radiation generated in the atmosphere. The influence of the terrestrial magnetic field on the azimuthal distribution of intensities of the penetrating radiation is by no means negligible; that on the east-and-west distribution is not greater than the errors of experiment. It is premature to draw inferences from this, but work is being carried out. A. D.

2536. Determination of H by a Coupled-Oscillations Method. L. G. Vedy. *Cambridge Phil. Soc., Proc.* 28. *pp.* 109–114, *Jan.,* 1932.—Two small equal magnets are suspended by silk threads from brass stands and placed on the same magnetic meridian at such a distance from one another that their magnetic lengths may be neglected, but so that there is considerable interaction between them. When one magnet is made to oscillate, coupled vibrations are set up between it and the second magnet, causing beats. From the beat-period and the distance apart of the magnets M/H is obtained and by allowing one magnet to oscillate alone, MH; hence the magnetic moment M and the earth's horizontal field are calculated. H. M. B.

2537. Remanent Magnetism of Rocks. J. Koenigsberger. *Gerlands Beitr. z. Geophys.* 35. 2. *pp.* 204–216, 1932.—The quotient obtained by division of the average remanence in the earth's field consequent on volume magnetisation, by the inductive magnetisation produced under the same conditions artificially with the same field strength, is defined as Q, the relative remanence. By heating various minerals and rocks in the laboratory, maintaining them in the earth's field, up to temperatures of 600° C. a value of Q is obtained between 5 and 9. The remanent magnetism of magnetite and other stones is investigated in the present work over the range of temperature, 585° to 500° C., *i.e.*, from the critical point of magnetite downwards. It is found that on subjecting the mineral to a magnetic field at any temperatures between 500° and 585° C. a magnetisation of the material follows, the magnitude of which is greater the nearer the temperature to 585°. The influence of time of action of the magnetic field is investigated, and it is found that even at 500° C. the exposure for 30 min. effects a weak magnetisation. At 490° C., however, demagnetisation takes place with remanence nil. The results are applied to geological data particularly with regard to volcanic rocks and minerals. S. G. B.

CURRENT ELECTRICITY, MAGNETISM AND ELECTROMAGNETISM.

2538. Influence of the Underlying Support on the Temperature-Coefficient of Resistance of Thin Layers of Platinum. G. Baintner. *Zeits. f. Physik,* 73. 9–10. *pp.* 691–699, *Jan.* 8, 1932.—It was observed in the case of disintegrated platinum layers kathodically turned into dust upon strips of Minos and Tempax glass that their temperature coefficient of resistance and their specific resistance depended on the underlying layer of material supporting them. In agreement with Braunsfurth [see Abstract 3909 (1931)] the cause is considered to be the deformation of varying magnitude due to change of temperature of the platinum layer on the underlying Minos and Tempax support. From the results of the measurements the influence of the deformation on the specific resistance of the layers is also computed. J. J. S.

2539. Connection between the Electric Conductivity of Barium Oxide and Electron Emission. W. Meyer and A. Schmidt. *Zeits. f. techn. Physik,* 13. 2. *pp.* 137–144, 1932.—An apparatus is described by which the conductivity and electron emission of barium oxide can be determined before and after it has been subjected, (1) to a constant temperature of about 1000° C. for several hours, or (2) to transverse electrolysis. Results show that prolonged heating does not reduce the oxide to the form in which electrons are emitted unless a reducing agent is present, but, on the other hand, electrolysis does produce this state. This seems to point to the formation of a sub-oxide in the latter case. H. M. B.

2540. Dependence of Electrical Conductivity of Rock-Salt Crystals upon Field-Strength. F. Quittner. *Zeits. f. Physik,* 74. 5–6. *pp.* 344–349, *Feb.* 16, 1932.—A recent paper by Hochberg is discussed [see Abstract 4281 (1931)]. It is asserted that all the experimental results in that paper, with one minor exception, are to be found in an earlier, more comprehensive paper by the present author [see Abstract 752 (1930)]. Hochberg's conclusion, that Ohm's law holds both for natural crystals and for those obtained from fused NaCl, is disputed. N. D.

2541. Hall Effect and other Physical Properties of Copper-Cadmium Alloys. W. Richards and E. J. Evans. *Phil. Mag.* 13. *pp.* 201–225, *Feb.*, 1932.—To test theories of electrical conduction in alloys, experiments are made to determine the Hall coefficients, the electrical resistance, temperature coefficient of resistance, thermoelectric power, specific heats and densities of various compositions of copper-cadmium alloys. The curves giving the relations between the electrical properties and the composition show, in general, singular points near the values of compounds $CuCd_3$, Cu_2Cd_3, Cu_4Cd_3 and Cu_2Cd. The Hall effect and temperature coefficient of resistance do not indicate a compound Cu_2Cd. Discontinuities are not very marked at the above-mentioned points in the density and specific heat graphs. Studying the results in relation to the equilibrium diagram shows that the variations in the electrical properties follow the changes of phase of the system. H. M. B.

2542. Wave-Mechanics Theory of Supraconductivity. R. Schachenmeier. *Zeits. f. Physik*, 74. 7–8. *pp.* 503–546, *Feb.* 23, 1932.—The wave equations appropriate to series electrons bound to the ions of the conducting crystal, and to free electrons scattered by these ions, are developed, at first assuming no interaction. The interaction is then introduced and the author succeeds in showing that electrons can pass, without scattering, through the lattice, which is subject to temperature vibrations, and can carry an electric current. This is possible because of a secular exchange which occurs between series and conduction electrons. With rise of temperature the temperature motion of the lattice ions increases and this causes the exchange frequency to increase, up to a certain limit when on account of resonance certain perturbation terms increase rapidly and cause an abrupt rise in the electrical resistance. For lead, a numerical estimate of the critical temperature when supraconductivity ceases is made and found to agree, in order of magnitude, with the experimental value. The author considers that wave mechanics is adequate to explain the phenomena of supraconductivity. W. S. S.

2543. Thermoelectric Forces of Lead and Tin down to the Temperature of Liquid Helium. G. Borelius, W. H. Keesom, C. H. Johansson and J. O. Linde. *K. Akad. Amsterdam, Proc.* 34. 10. *pp.* 1365–1371, 1931. *Comm. No.* 217*c from the Phys. Lab., Leiden.*—An account of the continuation of the measurements of thermo-e.m.f.s carried out by the authors in 1929 down to the temperature of liquid H. Measurements extended to the temperature of liquid He are described. These include the supraconductors Pb and Sn, and are the first of a series embracing other metals at the temperature of liquid He. The thermo-e.m.f.s were measured against a certain silver-alloy wire previously used as a normal. The method was almost identical with that previously employed. These measurements on Pb and Sn are of special interest as showing how supraconducting metals behave thermoelectrically below and in the neighbourhood of the critical temperature. The results are given in a table and in curves. For Pb the thermo-e.m.f. per degree (*e*) is continuous at the critical point, but there is a rapid change in the derivative *de*/*d*T, and thus also in the difference of the Thomson effects (σ) calculated from the Thomson formula $\sigma_{\mathrm{Pb}} - \sigma_{\mathrm{norm.}} = \mathrm{T}\,de/d\mathrm{T}$. This rapid change is in the Thomson heat of Pb. Thermo-e.m.f.s per degree were measured for Pb down to 1·7° K. and for Sn down to 4·8° K., in both cases against the silver-alloy wire. It is concluded that the thermo-e.m.f. per degree for a couple formed by supraconducting-lead and silver-alloy is small. Meissner's statement that for the couple Sn–Pb the thermoelectric force is zero is supported. A rapid change occurs in the case of Sn in *de*/*d*T (as for Pb) and hence in the Thomson heat, and in both metals the Thomson effect at the critical temperature rapidly falls from finite values to zero. J. J. S.

2544. Passage from Glow Discharge to Arc in the Rare Gases. M. J. Druyvesteyn. *Zeits. f. Physik*, **73.** 11–12, *pp.* 727–731, *Jan.* 15, 1932.—Describes a series of experiments made mainly in Ne and A, using a pressure higher than 3 cm. with tungsten spheres 1·8 mm. in diameter as electrodes. After an arc had burnt between the spheres two or three times, the gas being pumped out each time, the current voltage characteristic became steady, and could be reproduced. At the same time the temperature of the kathode was measured with a pyrometer; at the maximum voltage the temperature of the kathode was always 2000° ± 50° K. The results of the experiments are capable of at least a qualitative explanation by means of the thermal arc theory. H. N. A.

2545. Anomaly of the Obstructed Glow Discharge. W. Koch. *Zeits. f. Physik*, **74.** 3–4. *pp.* 209–215, *Feb.* 11, 1932.—Research was undertaken with the object of elucidating the anomaly of the phenomenon found by Güntherschulze [see Abstract 2634 (1930)]. The existence of the effect was established under rigorous experimental conditions. For the rare gases it was found that the curve connecting electrode distance with discharge potential consists of two branches of different character. It was also found that these two branches correspond to two different forms of discharge. For the branch corresponding to the greater electrode distances the normal glow discharge has superposed on it an auxiliary long-wave luminosity. In hydrogen a new form of curve connecting electrode distance and discharge potential was found. The initial fall of the potential in the case of the rare gases with small electrode distances signifies a transfer from a form of discharge of relatively high energy to a form of relatively low energy. A. W.

2546. Theory of Sparking Potential of a Pure Gas. Measurements with Hydrogen. K. Zuber. *Ann. d. Physik*, **12.** 6. *pp.* 665–700, *Feb.* 19, 1932.—A formula previously applied by the author to nitrogen [see Abstract 3214 (1930)] is applied to other gases and shown to possess various advantages. The formation of sparks in helium appears to depend on a different mechanism from that in nitrogen. Sparking potentials of very pure hydrogen are measured and the constants of Townsend's ionisation function of the electrons are calculated. The probability that a hydrogen ion arriving at the kathode will there release an electron is obtained, and an expression for this quantity, in terms of the work of extraction, is put forward. It is shown how to determine the mean free path of electrons in a gas by measuring the sparking potential first in a non-uniform and then in a uniform electric field. Different gases are shown to possess what may be called "corresponding sparking states." N. D.

2547. Spark Constant for Sparks at Different Limiting Potentials. M. Toepler and T. Sasaki. *Arch. f. Elektrot.* 26. *pp.* 111-114, *Feb.* 23, 1932.—The first part of this paper gives the sparking potentials for different kinds of sparks produced between points (sharp or blunt) and a sphere 10 cm. in diameter. Section (ii) describes determinations of the spark constants, by the usual method, for these different sparks and the results are tabulated in section (iii). The results show that the spark constant found from the initial breakdown potential, the negative brush limiting potential and that for the positive glow discharge is almost the same, while the spark constant found for the striated discharge or the positive brush discharge has a smaller value, which may be only half that for the other types of discharge. The results are discussed in their bearing on spark temperature. A. W.

2548. Quantity of Electricity Transferred in Electric Breakdown of Air. P. Rosenlöcher. *Arch. f. Elektrot.* 26. *pp.* 115-117, *Feb.* 23, 1932.—Oscillograph records of the potentials across a spark gap with a series condenser were used to determine the quantity of electricity passing across the gap in a spark discharge. With an electrode distance of 1 mm. between plate electrodes it was found that the quantity of electricity was approximately $1 \cdot 1 \times 10^{-6}$ coulomb, corresponding to roughly 10^{13} electrons. After the passage of this quantity the discharge passes over to the arc discharge. The measured value should be an upper limit. The starting of the breakdown requires a much smaller number of electrons, the number being certainly one to two orders of magnitude less. A. W.

2549. Gas Discharges at Very High Frequencies. L. Rohde. *Ann. d. Physik,* 12. 5. *pp.* 569-600, *Feb.* 5, 1932.—The behaviour of different gases in electric and magnetic alternating fields h.f. was investigated. The dependence of the ignition and discharge potentials on the pressure is shown graphically for a number of gases. In the case of the ordinary gases (such as air, nitrogen, hydrogen, oxygen) a sharply defined minimum occurs in the curve connecting potential and pressure and the minimum is found at lower pressures with shorter wave-lengths. With the rare gases this effect is much less and in the case of neon no dependence on the pressure is found between 2 and 0·2 mm. of mercury. With increasing frequency both the ignition and discharge potentials decrease. A marked change is found above $10^{6} \sim$. At $0 \cdot 7 \times 10^{8} \sim$ the discharge potential is constant again and for all the gases investigated except hydrogen has reached its smallest value. In the case of hydrogen the fall continues to a frequency of $1 \cdot 3 \times 10^{8} \sim$. The dependence on frequency and the production of high electron velocities are explained by pendular electron motions. The electrodeless ring discharge was obtained with frequencies as high as $1 \cdot 3 \times 10^{8} \sim$. In glass rings the discharge in some cases was somewhat like a string of oval beads and could be caused to rotate by means of a magnet. The great brightness of the light from the electrodeless discharges and the possibility of producing them at very low pressures make them particularly suitable for spectroscopic investigations. A. W.

2550. Distribution of Space-Potential in Striated and Other Forms of the H.F. Discharge. D. Banerji and R. Ganguli. *Phil. Mag.* 13. *pp.* 494-501, *Feb.*, 1932. *Supplement.*—Measurements are made by the Langmuir "exploring collector", in combination with a third "bobbin" electrode, of the space-potential, energy and electronic concentration in various forms of h.f. discharge in conical and cylindrical tubes. The results with conical tubes confirm the correctness of the "exploring collector" method as modified for application to h.f. discharges. In the non-striated forms of discharge in cylindrical tubes the electronic concentration falls with rise of space-potential. In the striated form the space-potential and electronic concentration drop to minimum values in the dark space. An abnormally high space-potential is characteristic of the "splasmoidal" type of discharge, but the electric field of force in the glow is low and comparable with the force in the other types of discharge. [See also Abstract 2401 (1931).] J. E. K.

2551. Effect of the Magnetic Field on the Striated Electric Discharge Figure. T. Itoh and K. Yoneta. *Imp. Acad. Tokyo, Proc.* 8. *pp.* 32–35, *Feb.*, 1932.—The results of Magnusson in applying a strong magnetic field to discharge figures led the authors to try similar experiments on striated discharge figures [see Abstract 1948 (1929)]. Firstly, the striated figure was generated on the dielectric and then the magnetic field was applied, when the amount and the direction of the strial shift were found to depend not only on the gas pressure and magnetic field, but in some degree also on the surface and boundary conditions of the dielectric. A large number of illustrations are included in the paper.
H. H. Ho.

2552. Kathodic Evaporation in Magnetic Field. E. Henriot and O. Goche. *Comptes Rendus*, 194. *pp.* 169–170, *Jan.* 11, 1932.—When kathodic evaporation occurs in a magnetic field the kathode, which may be of Ag, Cu, Sn, Zn, Pb, As, Sb or Si, being in hydrogen, and the anode in the form of a box with a slit towards the kathode and a screen on the opposite side, an image of the slit is formed on the screen by the (magnetically) directed, and a general film by the undirected, evaporation. Usually on dissolving away the evaporated material the image of the slit remains as a slightly blackish film. That this is due to carbon in the kathode is shown by the fact that with a carbon kathode only the slit image is formed, while the hydrogen pressure diminishes. With carbon, therefore, only "electrochemical" and accordingly directed, and no "normal" evaporation occurs, the carbon combining with and being subsequently separated from hydrogen [see Abstract 1113 (1927)]. This phenomenon affords a method of detecting small quantities of carbon. [See also Abstract 2020 (1931).] C. A. S.

2553. Motion of a Heavy Sphere in an Ionised Electric Field. M. Pauthenier and (Mrs.) M. Moreau-Hanot. *Comptes Rendus*, 194. *pp.* 260–263, *Jan.* 18, 1932.—The charge on the sphere is gradually acquired through the afflux of ions—that due to ions arriving through thermal agitation is negligible for spheres of radius $\nless 50\,\mu$. If Q is the charge acquired in time t, Q_0 the limit charge, $\lambda = Q/Q_0$, E_0 the field, r the distance of the sphere from the axis of the cylinder, and k the mobility of the negative ions, $d\lambda/(1-\lambda)^2 = kE_0dt/4r$. Spheres of Rose's metal (density δ) of radius a ($= 12$–$120\,\mu$), were dropped [see following Abstract] from a point P_0 on the axis of the vertical cylinder. If Q_0 were reached instantaneously the line of descent would be straight and inclined to the horizontal at $\tan^{-1} 4\pi\delta ga/9E_0^2$. This not being the case the line falls lower, the equations of motion (air resistance neglected) being $md^2\tau/dt^2 = 3E_0^2a^2\lambda$; and $d^2r/dt^2 = g$. These give trajectories nearly rectilinear, inclined to the horizontal at an angle whose tangent is some 31 % in excess of that given above. [See also Abstract 1324 (1932).] C. A. S.

2554. Control of the Motion of Small Metallic Spheres in an Ionised Electric Field. M. Pauthenier and (Mrs.) M. Moreau-Hanot. *Comptes Rendus,* 194. *pp.* 544–546, *Feb.* 8, 1932.—To test the theoretical conclusions [see preceding Abstract] the spheres were released at P_0, devoid of initial charge or velocity, in a uniform field of about 2400 volts/cm., which gave trajectories inclined at about 45°. The internal surface of the cylinder was coated with moist gelatin to retain the spheres, and lateral illumination enabled the trajectories to be photographed. Results agreed with theory with spheres of radius $> 20\,\mu$. C. A. S.

2555. Inelastic and Elastic Electron Scattering in Argon. A. L. Hughes and J. H. McMillen. *Phys. Rev.* 39. *pp.* 585–600, *Feb.* 15, 1932.—Measurements are made of the number and energy of the electrons scattered elastically by argon atoms through various angles from 10°–170° and for volt-velocities from 50–500 volts. All the curves exhibiting scattering coefficient against angle fall off sharply between 0° and 60°, but the 50- and 100-volt curves show a subsequent maximum, then a minimum and a final marked rise. The curves for higher volt-velocities agree well with those plotted from Mott's expression. The energy distributions of electrons scattered inelastically by the same gas at 10° are measured for 50-, 100- and 200-volt electrons. Curves showing (*a*) angular distributions of energy losses, and (*b*) dependence of angular distributions on the collision energy for various energy losses, are shown. The angular distributions of slow " ejected " electrons are studied for different collision energies. The curves show a general distribution over all angles with strong maxima at large angles. N. D.

2556. Angular Distribution in the Scattering of Slow Electrons by Gaseous Molecules. Parts II and III. C. Ramsauer and R. Kollath. *Ann. d. Physik,* 12. 5. *pp.* 529–561, *Feb.* 5, *and* 12. 7. *pp.* 837–848, *March* 4, 1932.—The zone method used in previous work [see Abstract 4088 (1931)] is now considerably improved by raising the number of zones from three to eleven. The range of volt-velocities is now from the excitation potential down to 0·6 volts, and of scattering angles from 15°–167°. The gases investigated are He, A, H_2, CO, CO_2, Ne, Kr and Xe. Curves are given, showing the number of electrons scattered in various directions, using polar as well as Cartesian coordinates. The character of the curves changes in going from higher to lower velocities. No correspondence has been discovered between these curves and the curves of effective cross-sections. A family resemblance among the curves for A, Kr and Xe is well marked at the higher voltages, but marked differences appear at the lower ones. The results agree very well with those of Bullard and Massey. [See Abstract 2784 (1931).] N. D.

2557. Geometric Electron Optics. Parts I and II. M. Knoll and E. Ruska. *Ann. d. Physik,* 12. 5. *pp.* 607–640, *Feb.* 5, *and pp.* 641–661, *Feb.* 19, 1932.—Quantitative consideration of changes in direction of the electrons in the intense electron beam of an ionic tube leads to the assumption of an undistorted geometric-optic structure of the beam in field-free space. In order to determine this structure an experimental investigation was made of the geometric-optical properties of electron

beams. A pin-hole disc was found to show the characteristics of a pin-hole camera, decreased diameter of the hole showing increased sharpness of the image but decreased brightness. By use of a magnetic concentration coil electron images of much greater contrast could be obtained, whose quality was comparable with the images given by a good glass lens. Electron images were also obtained using an electric field symmetrical with respect to the axis of the beam; in this case the images were rotated through 180° compared with those obtained with the magnetic concentration coil. When combined systems were employed, such as two concentration coils, magnetic concentration lens and electric dispersion lens, images were obtained in agreement with the laws of geometric optics. Investigation of the errors of electric and magnetic lenses showed that in the case of the magnetic lens " chromatic aberration " of the coil with non-homogeneous electron velocities gives rise to appreciable errors in the image, but that the " spherical aberration " of the arrangements used was too small to be observed. With the electric lens errors were found due to various causes, the main one being, in the arrangements used, distortion of the field at the net electrode. Application of geometric electron optics makes it possible to explain the behaviour of the beam in an electron tube. The analogy between light rays and the paths of point charges was brought out clearly by experiments in which the glass surfaces used with light rays were replaced by double electrodes of fine-meshed wire gauze maintained at a suitable difference of potential. A relation was found between the double electrode potential and the optical constants for the corresponding electric element in geometric electron optics.
A. W.

2558. Experiments Proving the Polarisation of Electrons. E. Rupp. *Phys. Zeits.* 33. *pp.* 158–164, *Feb.* 15, 1932.—Polarisation is the term used to describe the non-uniform angular distribution of the electrons reflected from two surfaces in succession. In the first group of experiments an electron beam of 80 kV velocity falls on two such surfaces at grazing incidence ($i = 89° 50'$). No polarisation is detected in the final beam when the surfaces are of Be, Al and Ni, but is definitely present for mirrors of W, Au and Th. In the second group a beam of 220 kV velocity electrons falls on a mirror of Au and the beam scattered through 90° is then transmitted through Au foil and gives diffraction rings which are photographed. The blackening in the rings is unsymmetrical, being a maximum for electrons twice scattered in the same direction. Curves showing the dependence of polarisation on the nature of the metal of the mirrors and incident electron velocity are given. That the polarisation is closely connected with the magnetic moment is proved by applying various magnetic fields to beams of electrons. Fair quantitative agreement with the results of theory is obtained.
N. D.

2559. Photo-E.M.F. of Selenium. V. Brazzoduro. *Accad. Sci. Torino, Atti,* 66. 6–8. *pp.* 150–156, 1930–1931.—Determines the e.m.f. excited by light in selenium cells of the second type. They are constructed according to Uljanin's method by fusing selenium between platinised glass. The photo-e.m.f. appears at the temperature of formation of the grey crystalline type of selenium (120° C.), and again at the temperature of formation of the grey metallic type (195° C.). It disappears entirely at fusion. The life of each cell lasts about a month, but may be restored by reheating. The e.m.f. is proportional to the incident light, maximum sensitiveness being at 540 mμ. The e.m.f. under the illumination from a lamp of 2000 c.p. is of the order of a microvolt. E. E. F. d'A.

2560. Photoelectricity and Rectification in Cuprox Rectifiers. V. Brazzoduro. *Accad. Sci. Torino, Atti,* 66. 6–8. *pp.* 157–162, 1930–1931.—Studies the photoelectric action and rectification of cuprox rectifiers at various temperatures. When the blocking layer is illuminated an e.m.f. of about 10^{-3} volt is generated between the copper and cuprous oxide, owing to the passage of electrons across the blocking layer in one direction. On raising the temperature to 110° C. rectification becomes zero; on cooling it does not regain its former value. In the case of a reduction of the temperature from 104° to 20° C. the greater resistance of the cuprox element increased 500 %, while the lesser increased 90 %. At the same time the photo-e.m.f. varied by 2500 %. A simple relation found by the author is that the photo-e.m.f. varies as the square of the resistance of the element to zero current. E. E. F. d'A.

2561. Photoelectricity and Rectifiers. R. Deaglio. *Accad. Sci. Torino, Atti,* 66. 14–15. *pp.* 396–405, 1930–1931.—Compares the photoelectric properties of cuprox rectifiers and selenium rectifiers. The cuprox rectifiers were provided with a transparent terminal in the shape either of brass wire gauze or sputtered gold on glass. Both types show a steadily increasing photoelectric current up to illuminations of 30,000 lux and beyond. The selenium rectifiers show the stronger rectifying action. If the photoelectric action in the cuprox rectifiers is to be compared to a Hallwachs effect, a limiting p.d. must exist, as in metallic alkali cells [see Abstract 941 (1931)]. E. E. F. d'A.

2562. Spectro-Photoelectric Sensitiveness of Thin Films of Alkali Metals. R. Suhrmann and H. Theissing. *Zeits. f. Physik,* 73. 11–12. *pp.* 709–726, *Jan.* 15, 1932.—Sodium atoms adsorbed on bright platinum or platinum black in layers thinner than monatomic form a double layer which strongly reduces the work of emergence and displaces the normal photoelectric sensitiveness towards the longer waves. Thicker layers produce a selective maximum probably due to selective absorption of light. The author uses this property for determining whether temperature is capable of influencing the optical properties of double layers. By using liquid air he is able to show that cooling increases the work of emergence in a manner roughly proportional to its diminution by heat.
E. E. F. d'A.

2563. Detection of High Photoelectric Absorption in Cæsium Vapour at Double the Series Limit. E. T. S. Appleyard. *Phil. Mag.* 13. *pp.* 300–305, *Feb.*, 1932.—A consequence of recent work on the probability of electron capture when α-particles are projected through a cloud of free electrons is that vapours should show pronounced absorption at twice their series limit. In the case of cæsium vapour the series limit is at $\lambda 3184$, hence absorption should occur between $\lambda 1500$ and $\lambda 1600$. Calculation shows that the absorption should be enormously greater than any previously known continuous absorption. Examination shows that there is no appreciable absorption, and doubts are thrown on the validity of the electron capture results. Other workers have reported similar negative results. A. H.

2564. Time-Lag in Gas Photoelectric Cells. P. Fourmarier. *Comptes Rendus,* 194. *pp.* 86–89, *Jan.* 4, 1932.—Exhaustive experiments have been made with a cell with an active grid as kathode, an anode and an auxiliary anode, the distances between which could be varied. The current curves show that the production of secondary electrons by impact of positive ions on the kathode is not important. The authors conclude that the time-lag is due to the fact that the gas is rather slowly ionised by the positive ions; this ionisation is of importance in the working of the cells. H. N. A.

2565. Stable Potential of an Insulated Electrode in a Triode. G. A. Beauvais. *Onde Élec.* 11. *pp.* 83–88, *Feb.*, 1932.—A fuller discussion is given of the phenomena previously described [see Abstract 2099 (1932)]. The two possible explanations based on (*a*) secondary emission and (*b*) ionisation of the residual gas in the valve are discussed, and it appears that the former, while easily accounting for certain features of the characteristic curves, offers a poor explanation of others. In the present state of knowledge concerning the effects considered it is, however, difficult to decide definitely between the two explanations, though the second seems to be the more probable. A. W.

2566. Shot Effect in Space-Charge Limited Currents. E. W. Thatcher and N. H. Williams. *Phys. Rev.* 39. *pp.* 474–496, *Feb.* 1, 1932.—The shot effect in space-charge limited currents from tungsten and thoriated tungsten was investigated. The abnormal fluctuations observed have been analysed and their cause traced to inherent mixed emission from the metal surface. The effect of age and heat treatment was studied for specimens of tungsten. A double grid valve was used for obtaining a space stream, consisting solely of electrons, and the conditions were determined under which this stream is governed by the laws of pure chance applying in the simple shot effect theory. With this arrangement space-charge measurements of fluctuations can be made over a considerable range with the same degree of precision attainable with temperature limited currents. The results obtained are shown graphically and are discussed theoretically. A. W.

2567. Motion of Electrons in Flames. K. Vogt. *Ann. d. Physik,* 12. 4. *pp.* 433–476, *Jan.* 21, 1932.—A comprehensive account of previous work on this subject with a description of a new method of measurement by means of an a.c. arrangement. The earlier work of H. A. Wilson [see Abstract 1079 (1900)] and of P. Lenard [see Abstracts 650 (1903) and 97 (1901)] are described, and the method of the transverse current. More recent investigations by Lenard have given for the order of magnitude of the velocity of migration of the carriers of electricity in flames the value $50{,}000\,\frac{\text{cm.}}{\text{sec.}}\Big/\frac{\text{volt}}{\text{cm.}}$, but other observations make the numerical multiplying factor doubtful. A more hopeful method which seemed to overcome the sources of error in the earlier work was used by the author of the present paper, that of the alternating current. A grid burner with a luminous flame was employed. The result of the experiments, however, was negative, as an unsymmetrical shifting of the field occurred and the determination of the actual velocity of migration of the electrons in flames by the a.c. method employed was thereby wrecked. The field symmetry was produced not only by the temperature difference of the electrodes, but was also due to the influencing of the kathode fall by electrons. Thus a positive result could only be expected where no kathode fall existed. The numerous researches undertaken to drive electrons by the kathode through into the measuring flame cannot succeed so long as a kathode fall exists, since this cancels out all entering electrons by recombination and so keeps them away from the interior of the flame.

J. J. S

2568. Velocity of Light by Electron Discharge Method. E. Rupp. *Zeits. f. Physik*, 74. 7–8. *pp.* 455–459, *Feb.* 23, 1932.—An approximate method for the velocity of light, based on measurements of velocities of rapidly moving electrons and their deflections in an electric field. The de Broglie relativistic relation $\lambda_1/\lambda_2 = v_2\sqrt{c^2 - v_1^2}/v_1\sqrt{c^2 - v_2^2}$ gives $c^2 = v_1^2\left\{[(\lambda_1/\lambda_2)^2 - 1] \Big/ \left[\left(\frac{\lambda_1/\lambda_2}{v_2/v_1}\right)^2 - 1\right]\right\}$; whence the author deduces a method for evaluating c from four linear measurements in the deflection apparatus and one determination of electron-velocity, v_1. This is interesting but approximate only, by reason of the form of the formula; the experiment gave $c = (2\cdot996 \pm 0\cdot075) \,.\, 10^{10}$ cm./sec. A. D.

2569. Ultra-Short Electromagnetic Waves. Part I. Generator for Ultra-Short Undamped Waves. Part II. Normal Waves and Dwarf Waves. G. Potapenko. *Phys. Rev.* 39. *pp.* 625–665, *Feb.* 15, 1932.—A description is given of apparatus for the production of ultra-short undamped electromagnetic waves by the method of Barkhausen and Kurz. An investigation was made of the method of detecting the oscillations by observing the current in the anode circuit of the generator. At a constant anode potential the current is approximately proportional to the amplitude of the oscillations. A comparison of generators with one and with two valves shows the advantages of the former. In certain cases the energy of the oscillations produced by single-valve generators can be considerably increased by a suitable choice of the " ballast " capacity of the generator. A method is developed for graphical representation of the work of ultra-short-wave generators. It is found that two kinds of ultra-short waves may be produced, the normal waves and the dwarf waves. The first have a wave-length approximating to that computed by Barkhausen's formula; the second have wave-lengths 2, 3 and 4 times shorter than the normal waves. The shortest waves of the 4th order given by a valve of the type R5 had a wave-length of 9·4 cm. The nature of these very short waves is discussed. A. W.

2570. Electronic Oscillations of Barkhausen and Kurz. A. Rostagni. *Accad. Sci. Torino, Atti*, 66. 2–5. *pp.* 123–130; 66. 6–8. *pp.* 217–223, *and* 66. 14–15. *pp.* 383–395, 1930–1931.—The presence of ions in a condenser of rarefied gas modifies its reactance. The space between the grid and the plate of a triode may be regarded as an inductance in parallel with a condenser. This model may explain the oscillations described as " electronic " by Barkhausen and Kurz in 1920. The author considers how the space charge may undergo oscillations, and the paths described by the electrons. E. E. F. d'A.

2571. Barkhausen-Kurz Effect from the Point of View of Wave Mechanics. K. Umeda. *Tokyo B.D., Sci. Reports*, 1. *pp.* 167–178, *Feb.* 29, 1932. *In German.*—The Barkhausen–Kurz effect for plane electrodes is dealt with under more general assumptions than those of Schuster [see Abstract 982 (1931)]. It is shown that a system similar to a band system of spectral lines is given and that the longest wave-band head corresponds with the wave-length calculated from the Barkhausen–Kurz formula, the anode potential being negative. A. W.

2572. Frequency Multiplication by the Use of a Condenser with Rochelle Salt Dielectric. V. Wologdin. *Zeits. f. techn. Physik*, 13. 2. *pp*. 82–84, 1932.—The dielectric constant of Rochelle salt, when the electric field is perpendicular to the C-axis of the crystal, depends on the field strength; also the static and dynamic characteristics connecting the charge on the plates of a Rochelle salt condenser with the field strength resemble very closely the B-H and hysteresis curves for iron. Such a condenser behaves in a network in a manner analogous to that of a coil with iron core, and may therefore be used for frequency multiplication. Arrangements using a Rochelle salt condenser are described and oscillograms given showing their operation, harmonics up to the fortieth or higher being readily obtained. A. W.

2573. Magnetic Susceptibility of Iron a Few Degrees above the Curie Point. L. Néel. *Comptes Rendus*, 194. *pp*. 263–265, *Jan*. 18, 1932.—The $1/\chi$-temperature (χ being susceptibility) curve for iron between 770° and 777° consists of rectilinear portions corresponding with different Curie constants, which decrease as the temperature increases. If the sample be repeatedly cooled and reheated, similar but slightly different curves are obtained, indicating a smaller susceptibility. [See Abstract 1745 (1932).] C. A. S.

2574. Diamagnetism of Liquid Mixtures. S. R. Rao and G. Sivaramakrishnan. *Indian Journ. Phys.* 6. *pp*. 509–526, *Feb*. 29, 1932.—The diamagnetic susceptibility values of binary liquid mixtures have been experimentally determined for the following eight cases: benzene with carbon disulphide, nitrobenzene, carbon tetrachloride, hexane and chlorobenzene respectively, hexane with chlorobenzene and nitrobenzene and acetone with chloroform. Graphs drawn between the percentage composition by weight and the specific diamagnetic susceptibilities, give straight lines in all the above cases, showing that the additive law is obeyed to within 0·5 %, this being the maximum percentage error. The significance of these results is discussed in the light of X-ray scattering by liquid mixtures. AUTHORS.

2575. Properties of Ferromagnetic Matter in Thin Sheets and Wires. A. Perrier. *Helv. Phys. Acta*, 5. 1. *pp*. 59–67, 1932. *In French*.—The author supposes a piece of ferromagnetic material to be divided into fragments, one, two or three dimensions of which are smaller than the mechanical and magnetic " regions of coupling " of the saturated elementary groups. He shows that according to his theory of ferromagnetism the specific properties of the substance should be quantitatively modified, and that at the same time definite anisotropics should be produced. This should appear in the first place in the magnetisation curves, and the magnetostriction; but at the same time the other properties which are affected by a magnetic field (electrical and thermal conductivity, thermoelectricity, elasticity) will alter. In addition spontaneous characteristic modifications may be expected for each of the groups of phenomena mentioned without any magnetisations when the division takes place. Finally a comparison is made with recent experimental results. H. N. A.

2576. Thermoelectric Properties of Ferromagnetic Substances. L. F. Bates. *Phil. Mag.* 13. *pp.* 393–412, *Feb.*, 1932. *Supplement.*—The results from a series of experiments on the thermoelectric properties of manganese arsenide in the form of short rods, show a marked change in the thermoelectric power when the substance passes from the ferromagnetic to the paramagnetic state. Both positive and negative Thomson effects were exhibited, in different samples, rods of the pure substance giving a negative coefficient at the ferromagnetic critical point. On the basis of the free electron theory of ferromagnetism of Dorfmann and Jaanus, a decrease is expected in the specific heat at this point, which is in agreement with direct calorimetric measurements. A full discussion of the results follows on the basis of modern ferromagnetic theories. S. G. B.

2577. Effect Exhibited by Ferromagnetic Materials in A.C. Fields. A. Esau and H. Kortum. *Zeits. f. Physik,* 73. 9–10. *pp.* 602–619, *Jan* 8, 1932.—A discussion of an effect exhibited between the mechanical characteristics of a material and its ferromagnetic properties when subjected to alternating magnetisation. The vibrational power is exhibited mechanically, when the elasticity of the material is affected by an alternating longitudinal magnetisation, by means of the torsional vibrations of the material. The apparatus is fully described. The amplitude of the torsional vibrations is only related to the frequency of the exciting field within wide limits, but when the frequency of the exciting field and the natural frequency of the mechanical vibrating system coincide, a maximum is reached, after which a slow drop is noted with further increase of frequency. The effect is examined for a variety of conditions and previous treatments. S. G. B.

2578. Theory of the Exchange Problem and of Residual Ferromagnetism. F. Bloch. *Zeits. f. Physik,* 74. 5–6. *pp.* 295–335, *Feb.* 16, 1932.—Slater's method of treating the problem of several bodies gives a " secular " equation, representing an exchange, in a certain form. This equation is transformed into a non-linear wave equation in three-dimensional space, in which the absolute value of the square of the wave function is interpreted as " spin density." The equation can also be regarded, as in Hartree's method, as an approximation equation giving the behaviour of the spin density, and is here applied to the phenomena of hysteresis and residual magnetism. A contribution to the statistical problem is made, in that a connection is established between the probabilities of the different configurations of a system at a certain temperature and Kennard's transformation function. N. D.

2579. Molecular Field Hypothesis. P. Weiss. *Ann. de Physique,* 17. *pp.* 97–136, *Feb.*, 1932.—The problem of the equation of state of ferromagnetic bodies is based upon two points: the obedience to the law of paramagnetism, and secondly the law of mutual action for the orientation of the elementary carriers of magnetic moments. A formula is suggested which meets the facts of the case in most respects, namely, $h_m = n \,.\, \sigma$, and shows the proportionality between the molecular field and the magnetisation. It includes the spontaneous magnetisation and its thermal variation, proportionality between magnetisation at saturation and the remanent magnetisation which imposes the existence of an elementary domain, the anisotropic phenomena of ferromagnetic crystals, paramagnetism below the Curie point, and the magnetic term derived from the specific heat and the magneto-thermal phenomenon. The examination of the facts, therefore, suggests a molecular field proportional to the intensity of magnetisation, and thus explains the strength of magnetisation of ferromagnetic bodies, by the law of paramagnetism, Heisenberg's theory, based upon the phenomena of the exchange between electrons, gives a result equivalent to the molecular magnetic law. This theory is found to be supported by numerous verifications. Sadron's experiments are shown to lead to a notion of the ferromagnetic moment being the basis of periodic classification of the elements, as also to illustrate the generality of the molecular field in both positive and negative cases. S. G. B.

2580. Statistics and Magnetism of Free Electrons. L. Brillouin. *Comptes Rendus*, 194. *pp*. 255–258, *Jan*. 18, 1932.—A given total magnetic moment due to the electron spins, of an assemblage of electrons may result from various distributions of electrons in different levels with their spins orientated parallel or antiparallel to the magnetic axis. Using the Fermi statistics, the author calculates the most probable distribution of electrons between parallel and antiparallel for each level. A coupling between the spins due to the exchange phenomenon is then assumed, and using a simple expression for the total energy of the system the most probable value of the total magnetic moment is determined. Thus magnetism of the Pauli type is arrived at with a Weiss molecular field due to the exchange coupling. W. S. S.

2581. Atomic Moments. (Miss) A. Serres. *Ann. de Physique*, 17. *pp*. 5–95, *Jan*., 1932.—The atomic moments of cobalt, chromium and iron were determined, also the Curie constants of paramagnetics and ferromagnetics above their critical temperatures. The moment of Co″ in sulphates is about 25·7; it varies with the mode of preparation of the sulphate. In chromium salts the chromic ion has a moment of 19·0 magnetons. In alum the series of values found points to the existence of mixtures. Ferrites are classed in three groups. In these the constant paramagnetism of the sesquioxide (*a*) is conserved in ferromagnetic combinations, (*b*) diminishes progressively in cadmium ferrite as the moment increases, and (*c*) disappears entirely in the ferrite of zinc. Among ferrites which possess the same structure, the moment resides in the ferric ion which always occupies the same position in the lattice. The constant paramagnetism, the magnitude of the moment and the existence of ferromagnetism are connected phenomena which are probably produced by the same mechanism. G. E. A.

2582. Relationship of the H.F. Permeability of Iron Wires to the Magnetising Field. M. Wien. *Phys. Zeits*. 33. *pp*. 173–175, *Feb*. 15, 1932.—In considering the relationship between the magnetic induction of ferromagnetic materials at high frequencies an inertia is found to exist which depends upon the frequency of the field. The present paper is an attempt to elucidate the reason for this. The permeability curve is divided and considered in three parts: (1) an initial part where the permeability is independent of the field so long as the latter is weak; (2) a linear increase of the permeability until, in the case now considered, H = 3; and (3) the part of the curve where the induction approaches saturation. In the latter part a magnetic after-effect is evident due to inertia of magnetisation. It is shown that the latter can be explained upon a hypothesis of the disturbance of the Ewing groups and the impact of the elementary magnets. Experimental details are given. S. G. B.

2583. H.F. Permeability of Thin Iron Wires and of Iron Compounds in Weak Fields. K. Volkova. *Zeits. f. Physik,* 74. 5. 6. *pp.* 388–395, *Feb.* 16, 1932.—The measurements of the axial permeability of very thin iron wires, and of powders of magnetite and other iron compounds, show a linear course of the real and imaginary components of the permeability, $\mu - i\rho'$, for waves from 90 to 111 m. in length. The powders were enclosed in glass tubes, the spaces between the grains being filled with solidified paraffin wax. H. N. A.

2584. Calculation of the Permeability of Wires, and a Cause for the Existence of Apparent Bands in the Magnetic Spectrum. W. Arkadiew. *Zeits. f. Physik,* 74. 5–6. *pp.* 396–417, *Feb.* 16, 1932.—Gives the curves and formulæ which make it possible to calculate the a.c. resistance r' and the self-induction of ferromagnetic wires, and to determine their "effective" permeability μ_1, and the absorption of energy U, in alternating fields. The author makes use of his theory in discussing the observations of Malov, of Strutt, of Volkova and of Wait. The complex permeability of the wire is $\mu' = \mu_1 - i\mu_2$. In addition the author uses $\mu = \sqrt{\mu_1^2 + \mu_2^2}$, the "mean" permeability, the "elastic" permeability μ and the "viscous" permeability $\rho' = b\mu$, which are independent of the period. H. N. A.

2585. H.F. Permeability of Ferromagnetic Materials. N. N. Malov. *Zeits. f. Physik,* 74. 5–6. *pp.* 431–432, *Feb.* 16, 1932.—A reply to the contention of Strutt [see Abstract 1398 (1932)] in that the author denies having found that there is any anomaly in the value of μ for nickel and that from Tables 2 and 3 of his original work the value of the permeability of nickel decreases linearly with increase of frequency. With certain kinds of iron, however, the anomaly has been found. He concludes by stating that the explanation given by Strutt regarding the difference in the absolute value of the permeability of two samples of the same iron wire does not seem to him to be valid. S. G. B.

2586. Magneto-Resistance and Magneto-Caloric Effects in Iron and Heusler Alloys. H. H. Potter. *Phil. Mag.* 13. *pp.* 233–248, *Feb.,* 1932.—Experimental evidence of the direct proportionality of the magneto-resistance change to the change of magnetic energy in the case of iron and Heusler alloys is given and discussed. The proportionality factor varies considerably for different substances. J. S. G. T.

2587. Reactance Theorem. W. Cauer. *Preuss. Akad. Wiss. Berlin, Ber.* 30. *pp.* 673–681, 1931.—Given a $2n$-terminal network of "dead" circuit elements, to the n pairs of terminals of which electromotive forces E_s of given common frequency w, are applied, the linear equations relating the electromotive forces and the corresponding currents J_s can be summed up in the matrix equation $\sum_{t=1}^{n} Z_{st}J_t = E_s (s = 1, 2, \ldots n)$. The author investigates the conditions which a matrix Z_{st}, regarded as a function of the frequency w, must satisfy for it to correspond to an actual network in which all the circuit elements are reactances (zero ohmic resistance). The theorem is an extension of one due to R. M. Foster [see Abstract 2343 (1924)] for the case of a two-terminal network. W. S. S.

2588. Classical Electrodynamics and the Conservation of Energy. W. F. G. Swann. *Frank. Inst., J.* 212. *pp.* 563–576, *Nov.*, 1931.—The author is concerned with the difficulty that classical electrodynamics leads to the energy equation:

$$v\int\left(\mathbf{E}_0 + \frac{[u\mathbf{H}_0]}{c}\right)\rho d\tau = \int\left\{\Delta v \cdot \left(\mathbf{E}_i + \frac{[u\mathbf{H}_i]}{c}\right)\right\}\rho d\tau + \frac{\partial}{\partial t}\int\left(\frac{\mathbf{E}_i^2 + \mathbf{H}_i^2}{2}\right)d\tau + c\int[\mathbf{E}_i\mathbf{H}_i]_n dS$$

for the action of an external field ($\mathbf{E}_0\mathbf{H}_0$) on an electron which itself produces the field ($\mathbf{E}_i$, $\mathbf{H}_i$). The velocity of the electronic charge at a point at which the charge density is ρ, equals $u = v + \Delta v$, where v is the velocity of the centre of the electron. The first term on the right invalidates the interpretation of the terms of this equation as: rate of doing work in the volume τ = rate of increase of energy in τ + flux of energy through the boundary surface S. It is shown that by a modification of Lorentz's fundamental force equation $\int\left(\mathbf{E} + \frac{[u\mathbf{H}]}{c}\right)\rho d\tau = 0$, the objectionable term in the energy equation disappears. The proposed modification is equivalent to associating with the electron, material mass of the same order of magnitude as the electromagnetic mass. W. S. S.

2589. Electrodynamics, and the Mutual Annihilation of Positive and Negative Electricity. W. F. G. Swann. *Frank. Inst., J.* 213. *pp.* 1–15, *Jan.*, 1932.—The mutual annihilation of positive and negative electricity with an accompanying radiation of the equivalent electromagnetic energy has been invoked to account for stellar heat. Electrodynamics, without further generalisation, has no way of admitting such annihilation accompanied by radiation. The generalisations necessary to provide logical meaning to the process are developed and discussed. In particular, it becomes necessary to extend the law of motion of electricity applicable to an electron as a whole, so as to apply also to that which remains of the electron when part of it is destroyed. AUTHOR.

APPARATUS AND INSTRUMENTS.

2590. Capacity of Electrometers. L. Dees. *Phys. Zeits.* 33. *pp.* 131–134, *Feb.* 1, 1932.—When electrometers are used to measure very small charges, errors can be introduced if the potential sensitivity and capacity are separately measured; they must be determined for the exact conditions, both mechanical and electrical, under which the instrument is to be used. Experiments have been carried out on the capacity of a thread electrometer, and it is found that this can vary more than twofold, with change of conditions. It appears to be a linear function of the sensitivity (scale divisions per volt). J. H. A.

2591. Methods of Determining Constants and Capacity of the Quadrant Electrometer. G. Nadjakoff. *Phys. Zeits.* 33. *pp.* 135–139, *Feb.* 1, 1932.—An experimental and theoretical examination of the method of determining the true, as opposed to the effective, capacity of a quadrant electrometer, together with the related constants (sensitivity, etc.) of the instrument. J. H. A.

2592. Formulæ for the Three Classes of Torsion Electrometers. G. Nadjakoff. *Comptes Rendus*, 194. *pp.* 546–549, *Feb.* 8, 1932.—If v_1, v_2, v_5, v_6, are the potentials of the four quadrants of an electrometer, and v_3, v_4 those of the two portions of the needle, assumed to be all different, and the needle is in equilibrium when between the quadrants 1 and 2, and 5 and 6, the general equation for equilibrium is $R\alpha = \{(v_1 - v_2)[v_3 - (v_1 + v_2)/2] + (v_5 - v_6)[v_4 - (v_5 + v_6)/2]\}\rho^2/4\pi\delta$, where $R\alpha$ is the torsion couple, ρ the radius of the needle, and δ its distance from the internal surface of the electrometer box. The condition for equilibrium for a quadrant electrometer is given by putting $v_3 = v_4$, $v_1 = v_5$, and $v_2 = v_6$; for a binant $v_2 = v_5$ and $v_1 = v_6$; and for a duant the same with absence of sector 4 of the needle. Further, quadrant and binant electrometers are shown to consist of two duant systems. **Errata,** *ibid.*, p. 920, March 7, 1932. C. A. S.

2593. Electrodynamic Arrangement to Measure Small Mutual Inductances. Application to Micrometers. A. Guillet. *Comptes Rendus*, 194. *pp.* 777–779, *Feb.* 29, 1932.—A moving system consisting of one or more " pancake " coils is suspended inside a solenoid. The moment of the couple experienced by this system, when currents flow in the solenoid and suspended coils is calculated. In particular, when the solenoid is connected in series with the primary coil of a small mutual inductance, and the suspended system with the secondary, the moment of the couple is $M = AI_0 i_0 \cos \phi$, I_0 and i_0 being the amplitudes of the primary and secondary currents respectively, ϕ their phase difference and A a constant. Such an apparatus, used in conjunction with a special balance-like arrangement previously described, is employed to calibrate micrometers. [See Abstract 2147 (1932).] N. D.

2594. Improved High Resistance Unit. H. C. Rentschler and D. E. Henry. *Rev. Sci. Instruments*, 3. *pp.* 91–92, *Feb.*, 1932.—High resistances having values from a few megohms to several hundred thousand megohms can be made by sputtering carbon or graphite on a glass spiral in an inert gas. Wires are sealed into the two ends of the spiral, the glass in the neighbourhood being painted with " gold solution " and baked. The spiral is finally sealed into an envelope, thoroughly evacuated and baked, and argon at a pressure of about 2 mm. of mercury is admitted. It is stated that such resistances obey Ohm's law, and that they have a temperature coefficient of about 0·7 % per degree C. G. E. B.

2595. Geiger-Müller Counter Connected to a Braun Tube. G. Medicus. *Zeits. f. Physik*, 74. 5–6. *pp.* 350–378, *Feb.* 16, 1932.—A method of using a Braun tube as an indicator for a Geiger-Müller counter, without using amplifiers, is developed. This permits the various discharge effects in the counter to be investigated, time measurements to be made and proper conditions of working of the counter to be ascertained. The Braun tube is also applied to the coincidence method of using two counters. The intensity of the " natural effect " is measured for various directions of the straight line joining the centres of the counters, and it is concluded that the effect is mainly due to Hess radiation. The probability that the counters will register the passage of a quantum of Hess radiation, at pressures of several cm. of Hg, is shown to be considerably less than 1. N. D.

2596. Electrometrical Measurements by the Piezoelectric Quartz Method. G. Fournier and M. Guillot. *J. de Physique et le Radium*, 3. *pp.* 102–104, *Feb.*, 1932.—Describes some additions to the apparatus of Fournier for measuring ionisation currents [see Abstract 1980 (1928)]. All the long connections insulated with amber and paraffin have been eliminated. A diagram of connections and a tabular statement show the course of the experiments. H. N. A.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

2597. Rationalisation of X-Ray Exposures. G. Simon. *Brit. J. of Radiology*, 5. *pp.* 65–74, *Disc.*, 74, *Jan.*, 1932.—In ordinary radiographic technique diagnostic exposures are stated in terms of the kilovoltage and the number of milliampere-seconds exposure, together with the focus-film distance, etc. Experience shows that nominally similar conditions do not always produce corresponding photographic effects. It is suggested that these variations are due to the difficulties of making measurements in brief exposures, to the vagaries of individual h.t. units and X-ray tubes, to factors depending on wave form, etc., and that they might be avoided by expressing exposures in terms of a photographic unit. Experimental results are given which show that the photographic method is probably feasible. In the course of the discussion it was suggested that a representative committee be set up to examine the possibility of setting up a photographic standard of X-ray exposure. G. E. B.

2598. Energy Requirements of X-Ray Apparatus. K. W. Müller. *E.T.Z.* 53. *pp.* 106–107, *Feb.* 4, 1932.—Whereas large radiological institutes have their own generating apparatus, the majority of private houses and smaller hospitals obtain their current from the local supply. Therapeutic apparatus requires only a small and regular power consumption; diagnostic apparatus, whilst screening is being performed, also requires a small regular power consumption, but whilst radiographic exposures are being made, a large power requirement for a very short interval (which may be only some hundredths of a second) is demanded and for the latter requirement the power supply may experience difficulty. The load taken depends upon the type of rectifier, *i.e.*, whether the X-ray tube is self-rectifying, or the energy supplied to the X-ray tube is first rectified by means of thermionic valves. The tube consumption is usually taken as the product of tube voltage and tube current divided by $\sqrt{2}$, but as a sine-form voltage curve is not involved, this method of computation is not really correct. Also difficulty arises in the correct measurement of the tube current. In order to compensate for this error a factor c is introduced, which, for half-wave rectification, is about 0·38 and for constant-potential operation 0·52. The question of phase difference is briefly discussed. The load which can be carried by a thermionic X-ray tube depends upon its construction as well as the type of high tension utilised, and various energy values are given for different types of tube manufactured by Müller of Hamburg and their suitability discussed for particular forms of h.t. operations. B. J. L.

2599. Use of Inert Gases for the Production of Ultra-Violet Radiation. (Mrs.) J. Goude-Axelos and A. Claude. *Comptes Rendus*, 194. *pp.* 132–134, *Jan.*, 1932.—Krypton and xenon, which can now be obtained fairly easily as a by-product of the manufacture of oxygen and nitrogen, have spectra extending well into the ultra-violet, and also showing a large number of lines. In order to utilise this for therapeutic and other purposes, a lamp was constructed of a pyrex glass tube 3 cm. diameter and 14 cm. long closed at one end by a quartz plate, which contained either or both gases at a suitable pressure. The spectrum was excited by means of an electrodeless discharge induced by a suitable external coil. A similar lamp containing suitable proportions of argon, krypton, neon and xenon could be made to give practically white light.

G. E. B.

2600. Xenon Lamp for Short Wave-Length Ultra-Violet Rays. P. Harteck and F. Oppenheimer. *Zeits. f. phys. Chem.* 16. *Abt.B.* 1. *pp.* 77–80, *Jan.*, 1932.—A new source of ultra-violet light is described. This is a low-voltage xenon lamp which can take a current up to 50 amperes. Measured photochemically, the intensity of the beam (wave-lengths 1295 Å. and 1469 Å.) is 3×10^{17} quanta per sec. A fluorite window is employed. The life of the lamp is several hundred hours, and the intensity is constant.

J. T.

2601. New Mercury-Vapour Lamp. W. Harries and A. v. Hippel. *Phys. Zeits.* 33. *pp.* 81–85, *Jan.* 15, 1932.—A new mercury-vapour lamp is described in which the burner consists of either glass or quartz and forms a slit-shaped source of light of high surface brightness. The lamp lights automatically, burns with a very small consumption of power and with a correspondingly small development of heat. The arc is very quiet and can be reproduced in any position of the lamp. The position of the lamp can be fixed by hand. The lamp is inexpensive initially, and in service, and has a mean life of several thousand hours. J. T.

2602. Ultra-Violet Radiation from the Carbon Arc and its Dependence upon Arc Length and Energy Input. E. A. Owen and P. Wright. *Brit. J. of Radiology*, 5. *pp.* 120–147, *Feb.*, *and pp.* 324–341, *April*, 1932.—By means of an aluminium photoelectric cell with a quartz window the ultra-violet emission of carbon arcs in relation to arc length was studied in the case of constant power input. The range of power input varied from 83 to 1600 watts. It is found that, with increasing arc length, the ultra-violet emission rises to a maximum and then usually falls off somewhat. A slightly higher emission is noted in the case of " hissing " arcs. When emitting maximum intensity, the length of the arc is practically a linear function of the power input. G. E. B.

2603. Ionisation Chambers of Very Small Dimensions for Local Measurements of γ-Radiation. L. Mallet. *Comptes Rendus*, 194. *pp.* 370–372, *Jan.* 25, 1932.—Details are given of an ionisation chamber, consisting of a condenser of very small capacity with a negligible natural leak, for determining the intensity of γ-radiation in a well-defined region, as required in biological investigation. The external diameter of the condenser, which may be hemispherical or plane, is only 2·8 mm., and it is connected to an electroscope the spherical cavity of which has a diameter of 12 mm. The total capacity of the system is 2 cm. C. B. A.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

2604. Comparison of Methods for Determining Areas of Adsorbed Molecules in Interfacial Films. F. E. Bartell and G. L. Mack. *J. Phys. Chem.* 36. *pp.* 65–85, *Jan.*, 1932.—The interfacial surface tension, S_{23}, for solutions of various strengths of $PhNO_2$ in (*a*) C_6H_6, (*b*) C_7H_8, (*c*) PhEt and (*d*) PhBu were determined by the Bartell–Miller method [see Abstract 2895 (1928)]. The area of an adsorbed molecule is then deduced from the equation $q\mathrm{RT} = -dS_{23}/d \log_e c$, where q is the number of molecules adsorbed per cm.^{2}, by three methods: (i) maximum adsorption; (ii) the mixture law; and (iii) a modified mixture law, the thickness of the film, t, being given by $t = \{q + (c^2/\mathrm{N})^{1/3}\}c'$, c and c' being respectively the bulk and interfacial concentrations in mol./cm.^{3} The molecular areas of $PhNO_2$ deduced by the three methods at 25° are respectively, in (*a*) 30·6, 34·6, 23·2; in (*b*) 30·6, 29·7, 21·5; in (*c*) 30·6, 27·2, 20·6; in (*d*) 30·6, 24·8, 21·0; the average of all results, including determinations in (*a*) and (*b*) at 15° and 35°, is 30·6, 32·1 and 21·8 Å.^{2}. Similar areas for $PhNMe_2$ in C_6H_6 are 35·5, 41·5, 26·6. The comparative validity of the three methods is discussed, and none shown to be free from objection. All give results of the same order as those deduced from X-ray diffraction methods. [See Abstract 218 (1930).] C. A. S.

2605. Langmuir's Adsorption Theory and Freundlich's Isotherm. A. Ganguli. *Indian Phys. Math. J.* 3. *pp.* 53–59, *Jan.*, 1932.—Further considerations on the lines previously followed [see Abstract 2312 (1930)] are developed. T. H. P.

2606. Vapour Pressure Isotherms and the Submicroscopic Structure of Active Charcoal. P. Kubelka and Margarete Müller. *Kolloid Zeits.* 58. *pp.* 189–197, *Feb.*, 1932.—The earlier investigations [see Abstract 3256 (1931)] are continued on a series of new vapours, a series of new active charcoal samples and on two silicic acid samples. The investigations are also furthered with reference to variation in temperature. The structural rules for active charcoal, previously established, are confirmed. On the other hand, the rules are found not to be applicable to silica gel. J. K.

2607. Active Carbon. E. Berl, K. Andress, L. Reinhardt and W. Herbert. *Zeits. f. phys. Chem.* 158. *Abt.A.* 3–4. *pp.* 273–289, *Jan.*, 1932.—Examination of the X-ray spectra of a variety of forms of active carbon, prepared by widely differing methods, show that no amorphous carbon is present, and that the difference between the properties of active carbon and graphite is attributable to a breaking-down of the three-dimensional graphite lattice and the production of a mesomorphic phase, *i.e.*, a phase which exhibits periodic arrangement in only one, or at most two phases. The electrical conductivities of the specimens bear no relationship to the degree of activity, and may, according largely to the temperature of preparation, be of approximately the same value as that of graphite; the conductivities also afford no support to the theory that an amorphous form of carbon is responsible for the activity. The specimens exhibit extraordinarily great elasticity: the apparent density of certain varieties is quadrupled by subjecting the carbon to a pressure of 350 atmospheres, and on restoration of normal pressure the apparent density reverts to nearly its normal value. The activity of carbon cannot be ascribed definitely either to general surface activity or to the presence of active centres, but probably results from the operation of both of these factors.

H. F. G.

2608. Selective Adsorption by Activated Charcoal from Solutions containing Two Organic Acids. C. Ockrent. *Chem. Soc., J. pp.* 613–630, *Feb.*, 1932.—It is pointed out that few attempts have been made to investigate the simultaneous adsorption from solutions containing two or more surface-active solutes. A new method for determining the concentration of mixtures of small amounts of two weak acids in solution is given. Adsorption isotherms of benzoic, salicylic, *o*-toluic, monochloracetic, acetic, formic and trichloracetic acids at 25° ± 0·02° are given in connection with activated ash-free sugar charcoal. The results are stated to be in good agreement with the Langmuir adsorption isotherm.

J. K.

2609. Activated Silica Gel. F. E. Bartell and E. G. Almy. *J. Phys. Chem.* 36. *pp.* 475–489, *Feb.*, 1932.—The present work refers to the relation of the activity to water content and temperature of activation. The heats of wetting by water as a measure of activity are used to determine the conditions under which silica may be activated reproducibly. It is found that the activation temperature must be carefully controlled for successive portions of the gel to be activated to the same extent. For maximum activity this temperature is in the neighbourhood of 300° C. It is shown that the water present in a gel before activation is not all held in the same manner. J. K.

2610. Silicic Acid Gels. C. B. Hurd and H. A. Letteron. *J. Phys. Chem.* 36. *pp.* 604–615, *Feb.*, 1932.—The present paper deals with measurements on surface tension during setting and the effect of temperature on the time of set. The variations of surface tension of a mixture of solutions of sodium silicate and acetic acid during the process of gelation are given. A value for Q in Arrhenius' equation, called the " heat of activation," is calculated for purely chemical reactions. J. K.

2611. Adsorption of Binary Vapour Mixtures on Silica Gel. B. S. Rao. *J. Phys. Chem.* 36. *pp.* 616–625, *Feb.*, 1932.—A circulation pump for the study of the adsorption by a dynamic method is described. The binary mixtures used are benzene-alcohol, benzene-carbontetrachloride, water-alcohol and water-acetone. An explanation is given to account for the selective adsorption on silica gel. J. K.

2612. Rate of Adsorption from Solution. L. E. Swearingen and B. N. Dickinson. *J. Phys. Chem.* 36. *pp.* 534–545, *Feb.*, 1932.—The influence of the nature of the adsorbent on the rate of adsorption from true solutions is studied. It is determined how the nature and concentration of the adsorbate influence the rate of adsorption and also how the rate of adsorption is influenced by the rate of stirring. The solutions used are aqueous solutions of monochloracetic, dichloracetic and trichloracetic acids. Charcoal and silica gel are used as adsorbents. The adsorption is followed by an electrical conductance method. With vigorous agitation, 75 to 80 % of the adsorption takes place so as to be directly proportional to the concentration of the solute. J. K.

2613. Anomalous Initial Heat of Adsorption. G. M. Schwab and W. Brennecke. *Zeits. f. phys. Chem.* 16. *Abt.B.* 1. *pp.* 19–42, *Feb.*, 1932.—From measurements of the heat of adsorption of hydrogen on copper it is shown that there is no maximum in the curve obtained by plotting heat of adsorption and amount adsorbed. The heat of adsorption shows a slight fall with increasing adsorption of gas. F. J. W.

2614. Influence of Particle Size on the Heat of Wetting of Powdered Adsorption Substances. F. Krczil. *Kolloid Zeits.* 58. *pp.* 183–189, *Feb.*, 1932.—Six powdered adsorption substances of different characteristics are fractionated by sedimentation by methods previously described into fractions of definite particle size [see Abstracts 3255 and 3606 (1931)] and the heat of wetting by absolute alcohol and benzene is determined. The decrease of heat of wetting with increase of fineness of the adsorption substances as established by W. Wildi was not observed. According to the present author the heat of wetting using alcohol and benzene is independent of the size of the particles. J. K.

2615. Reversal of the Heat of Wetting Succession by Previous Treatment of the Wetted Powder. B. Iliin and S. Wassilieff. *Zeits. f. phys. Chem.* 158. *Abt.A.* 5–6. *pp.* 365–368, *Feb.*, 1932.—The heat of wetting of powdered floridin with aqueous solutions of methyl alcohol of varying concentration has been studied. The change of the heat of wetting with concentration of alcohol can be completely reversed by suitably heat-treating the floridin before use. F. J. W.

2616. Theory of Rate of Solution of Gas in Liquid. S. Miyamoto. *Chem. Soc. Japan, Bull.* 7. *pp.* 8–17, *Jan.*, 1932. *Hiroshima Univ., Journ. Sci.* 2. *pp.* 73–84, *Feb.*, 1932. *In English.*—The rate of solution is measured by the difference between the numbers of molecules of gas entering and escaping from the liquid, it being assumed that only those molecules can enter or escape from the liquid which possess a definite minimum component of velocity perpendicular to the interface—respectively u_0 and u_0'. This gives as the general equation:

$$\sqrt{2\pi}\mathrm{M} \,.\, dn/dt = \mathrm{S}(e^{-\mathrm{M}u_0^2/2\mathrm{RT}} \,.\, p/\sqrt{\mathrm{RT}} - e^{-\mathrm{M}u_0'^2/2\mathrm{RT}} \,.\, c_1\sqrt{\mathrm{RT}}/1000),$$

where c_1 is the concentration of gas in the liquid phase, M mol. weight of gas, n the number of moles of gas absorbed, p partial pressure of gas, R the gas constant, S area of interface and T absolute temperature. This can be reduced to $dn/dt = \mathrm{KS}(c - c_1)$, where c is the concentration of the saturated solution of the gas, and K a constant, which is quite similar to Donnan and Massey's equation based on the theory of rapid reaction at the interface followed by slow diffusion. The author's previous results regarding the rate of oxidation of sodium sulphite, leading to the deduction that the maximum of this rate is that of solution of oxygen, with $1 \cdot 65 \times 10^5$ cm./sec. as the value of u_0 are shown to be in agreement with the theory. C. A. S.

2617. Statistical Mechanics of Dilute and of Perfect Solutions. E. A. Guggenheim. *Roy. Soc., Proc.* 135. *pp.* 181–192, *Feb.* 1, 1932.—In the author's previous paper on the subject no reason was found why the laws of dilute solutions should take the particular form corresponding to the mole-fraction scale of concentration, except analogy with the laws of perfect solutions. In the present paper an attempt is made to remedy this omission by considerations of statistical mechanics. The method used is that of partition functions, described in Fowler's text-book. The thermodynamic functions used are the two characteristic functions Ψ and Φ of Planck. Shows that Fowler in the few paragraphs he has devoted to dilute solutions gives a treatment which is open to criticism. His argument seems to be due to a false analogy between dilute solutions and perfect gases, probably suggested by the popular but false analogy between osmotic pressure and gaseous pressure. In a liquid the volume occupied by the liquid is not determined by the containing vessel, as is the case with gases. The author finally arrives at an expression for the vapour pressure of the solution, which agrees with Raoult's law in the mole fraction scale. Osmotic pressure, and the case of perfect solutions, are also dealt with by means of the correct theory. H. N. A.

2618. Constitution of Colloidal Gold. W. Pauli and E. Russer. *Kolloid Zeits.* 58. *pp.* 22–44, *Jan.*, 1932.—Results are given of determinations of the conductivity, H-ion concentration, etc., of gold sols, and of experiments on the coagulation, etc., of such sols. The main outcome of the results obtained is the removal of the difficulties which have previously prevented the complete acceptance of the theory that gold sols contain ionogenic charged surface gold complexes. T. H. P.

2619. Modes of Combination of Water in Gels. G. F. Hüttig. *Kolloid Zeits.* 58. *pp.* 44–61, *Jan.*, 1932.—Consideration of published work on the vapour-pressure curves and of the X-ray spectrograms of systems containing combined water leads to the recognition of the following ways in which the water may be combined: (1) Crystalline hydrates of stoichiometric composition, in which the water molecules are chemically combined and occupy fixed positions in the crystal lattice; the isobaric and isothermal dehydration curves show the known step form. (2) Mixed crystals. (3) Amorphous hydrates of stoichiometric composition. (4) Hydrogels with capillary-bound water. (5) Crystalline and amorphous substances with osmotically-bound water. (6) Sorbed water. (7) Mixed types, in which the water is bound in two of the preceding ways. T. H. P.

2620. Bound Water in Colloids. D. R. Briggs. *J. Phys. Chem.* 36. *pp.* 367–386, *Jan.*, 1932.—A theoretical basis for "bound" water determinations is outlined in terms of the relative vapour pressure-water content curve (vapour pressure isotherm) of the colloid. "Bound" water is defined as that portion of the water in a system containing colloid and crystalloid which is associated with the colloid, together with those ions which form a part of the colloid complex. At any given activity of the water in a system, in which colloids and crystalloids are in equilibrium provided the various non-water components have not reacted with each other, the amount of water associated with or "bound" by a given weight of any of the non-water components will always be the same, and it will be the same as that which the given weight of the component will be associated with at the same water activity. When it is the only non-water component present in the system, some of the methods which have been used for the determination of "bound" water are interpreted in terms of this picture. H. H. Ho.

2621. Free and Bound Water in Elastic and Non-Elastic Gels. I. D. Jones and R. A. Gortner. *J. Phys. Chem.* 36. *pp.* 387–436, *Jan.*, 1932.—This paper deals with free and bound water in elastic and non-elastic gels. Dilatometric studies have been made of the state of the water in the following aqueous colloidal systems as affected by exposure to temperatures ranging from 0° to – 50° C.: gelatin gels, the thick portion of egg white from fresh eggs, mixtures of different concentrations of activated silica gel and water, and hydrated ferric hydroxide. The rate of establishment of ice-gel equilibrium was found to be very slow and influenced by concentration and temperature. It is emphasised that " bound " water is an indeterminate term, and that " bound " water values as experimentally determined may be expected to vary from system to system. H. H. Ho.

2622. Solvation Equilibrium in Colloidal Solutions. G. V. Schulz. *Zeits. f. phys. Chem.* 158. *Abt.A.* 3–4. *pp.* 237–257, *Jan.*, 1932.—The simplified form of van der Waals' equation may be applied to a large number of colloidal solutions (rubber in benzene or benzine, nitrocellulose in acetone, gelatin in water) if the molecular weight is taken as constant and the solvation as a function of the concentration. It is shown that the solvation of the colloidal particles depends on the osmotic pressure of the sol and, in order to express this dependency, a new magnitude—the solvation pressure—is introduced, this being equal to the osmotic pressure for a condition of equilibrium. On the assumption that solvation and swelling depend on the same cause, the dependency of the solvation pressure (and that of the osmotic pressure) on the concentration in the disperse phase should obey the same law as the dependency of the swelling pressure on the concentration in the gel, namely, $P = kc^v$. The same equation is found to hold for the relationship between the solvation pressure and the concentration in the disperse phase (solvation equation). The mean value of v for both osmotic pressure and swelling is 3. If the volumes of swollen gel are extrapolated according to the above Freundlich–Posnjak equation to the low pressures given by osmotic measurements for osmotic pressures, exactly the same values are obtained as those determined for co-volumes from osmotic measurements. T. H. P.

2623. Coagulation of Homogeneous Aerosols. H. S. Patterson. *Phil. Mag.* 13. *pp.* 523–527, *Feb.*, 1932. *Supplement.*—Calculates a new equation giving the relationship between particulate volume and time for an ærosol initially homogeneous. The equation is obviously not linear, and consequently the course of coagulation cannot be represented by a straight line. Actually the curve is generally beyond the limits of experiment. [See Abstract 375 (1930).] E. E. F. d'A.

2624. Nature of the Metallic State. A. Eucken. *Zeits. f. Metallkunde,* 23. *pp.* 293–296, *Nov., and pp.* 329–334, *Dec.*, 1931.—The results of modern theory of matter are applied to the metallic state. The presence of free electrons and the proof of their existence in metals are outlined. The typical properties of metals, specific heat, electrical conductivity, conductivity of heat and the Wiedemann–Franz–Lorenz number, and ferromagnetism are discussed. The calculation of the characteristic constants for the material properties is not wholly satisfactory. The reasons are to be found partly in the complexity of the calculations, and partly in the physical data used in the calculations. F. J. B.

2625. Solubility of Silver in Copper, by an X-Ray Method. P. Wiest. *Zeits. f. Physik,* 74. 3–4. *pp.* 225–253, *Feb.* 11, 1932.—The solubility of silver in copper is determined for single crystals and for polycrystalline material, by measurement of the lattice parameters. It is found that the solubility of a single crystal is higher than that of a crystal aggregate. It is also found that in the case of a single crystal it takes longer to attain equilibrium on tempering than it does in the case of polycrystalline material. Observations are also made on the effect of impurity.

J. T.

2626. Iron-Mercury System and Solubility of Nickel in Mercury. Eva Palmaer. *Zeits. f. Elektrochem.* 38. *pp.* 70–76, *Feb.*, 1932.—The solubility of iron in mercury was determined by rotating an amalgamated iron wire in a quantity of mercury. The iron was then determined by colorimetric analysis, after removal of the mercury. It was found that the iron dissolved amounted to 0·00007 % by weight and varied only with the temperature between 20° and 211° C. The crystals which separate from mercury deposited on iron by electrolysis are not a definite compound of iron and mercury, but consist of pure iron separated out from the mercury. The solubility of nickel, determined by a similar method, was found to be 0·0014 % by weight at 20° C.

F. J. B.

2627. X-Ray Examination of Iron-Chromium Alloys. G. D. Preston. *Phil. Mag.* 13. *pp.* 419–425, *Feb.*, 1932. *Supplement.*—An accurate determination is made of the parameter changes in the iron-chromium system, which consists of a continuous series of solid solutions. It is suggested that the parameter does not vary continuously with the composition. J. T.

2628. Heats of Combustion of Methyl and Ethyl Alcohols. F. D. Rossini. *Bureau of Standards, J. of Research,* 8. *pp.* 119–140, *Jan.*, 1932.—The heats of combustion of gaseous methyl and ethyl alcohols, at saturation pressure, from their mixture with air, under a constant total pressure of 1 atmosphere, were found to be 763·68 ± 0·20 for methyl alcohol at 25° C. and 1407·50 ± 0·40 for ethyl alcohol at 32·50° C., in international kilojoules per mole. By combining with these data the heats of vaporisation recently determined by Fiock, Ginnings and Holton and correcting the data for ethyl alcohol to 25° C., the heats of combustion of the alcohols in the liquid state are computed to be 726·25 ± 0·20 for methyl alcohol and 1366·31 ± 0·40 for ethyl alcohol, at 25° C. and a constant pressure of 1 atmosphere, in international kilojoules per mole. With the factor 1·0004/4·185 these values become, respectively, 173·61 ± 0·05 and 326·61 ± 0·10 k.-cal.$_{15}$ per mole. It was found that a rapid and accurate determination of the ratio of carbon to hydrogen in a volatile organic liquid can be made by saturating a stream of inert gas with the vapour of the liquid and then passing the mixture through hot copper oxide. AUTHOR.

2629. Heat of Formation of Ozone. P. Günther, E. Wassmuth and L. A. Schryver. *Zeits. f. phys. Chem.* 158. *Abt.A.* 3–4. *pp.* 297–304, *Jan.*, 1932.—The value of − 34·22 ± 0·18 k.-cal./mol. has been found by direct determination of the heat of formation of ozone by the explosion method at constant volume. H. H. Ho.

2630. Affinity and Heat of Hydration of Doubly-Linked Carbon. W. Hiltner. *Zeits. f. phys. Chem.* 158. *Abt.A.* 5–6. *pp.* 398–410, *Feb.*, 1932.—The affinities and the heats of hydration of carbon compounds containing carbon atoms connected by double bonds were determined. The oxidation and reduction potentials of the unsaturated compounds were measured in systems consisting of saturated/unsaturated compounds. The oxidation and reduction potentials were measured for crotonic acid/ethyl butyrate, *n*-propyl ester and *n*-butyl ester and for cinnamic acid/hydrocinnamic ester. The current-voltage curves yield grounds for the belief that a protective layer is formed at the electrode which causes the reaction to cease. The affinities, determined by the potential measurements, are not in agreement with those determined by the heat of hydration. F. J. B.

2631. Problem of the Chemical Bond. Part II. F. Hund. *Zeits. f. Physik*, 73. 9–10. *pp.* 565–577, *Jan.* 8, 1932.—This series of papers is for the elucidation of valency bonds in organic chemistry [see Abstract 1448 (1932)] and from considerations based on the work of Slater, Pauling, etc., a simple system of valency rules has been derived. In the case of localised unions, the empirical rules of organic chemistry are deduced when certain energy assumptions are made. Benzene is discussed as a case of non-localised unions. An Appendix contains a proof of the validity of the energy assumptions made. H. H. Ho.

2632. Theory of Non-Adiabatic Chemical Processes. F. London. *Zeits. f. Physik*, 74. 3–4. *pp.* 143–174, *Feb.* 11, 1932.—A purely mathematical paper, in which it is shown that although the static theory of atomic forces developed on the basis of quantum mechanics requires extension to the dynamics of chemical reactions, application of the method of attack used by Born and Dirac for electron impact to the problem of the impact of atoms is unsatisfactory, at least for ordinary temperatures. A dynamic theory of the simplest type of bimolecular reaction has therefore been developed in which the chemical aspect of the problem is dealt with directly. The theory, which is purely mathematical, is discussed in its application to simple reactions such as those between potassium and chlorine and between hydrogen and chlorine. A perturbation method is described which permits a relatively simple calculation of the reaction velocity of non-adiabatic chemical processes. H. F. G.

2633. Velocity Coefficients of Exchange Reactions. H. Pelzer and E. Wigner. *Zeits. f. phys. Chem.* 15. *Abt.B.* 6. *pp.* 445–471, *Feb.*, 1932.—A purely mathematical discussion of London's theory of the adiabatic nature of chemical exchange reactions; the principal necessary condition is that the lowest energy level shall differ widely from the others. The absolute velocity constant of the decomposition of parahydrogen into normal hydrogen has been calculated. H. F. G

2634. Photochemical Decomposition of Chloroform. D. G. Hill. *Am. Chem. Soc., J.* 54. *pp.* 32–40, *Jan.*, 1932.—If chloroform vapour is exposed in a quartz bulb to the action of radiation from a condensed spark between Al or Zn electrodes no evidence of decomposition is obtained, probably since the organic decomposition products are deposited on the walls of the vessel and absorb the incident radiation. If on the other hand the $CHCl_3$ vapour is allowed to stream past the spark, HCl is formed, together with unidentified organic substances. The decomposition proceeds as a short-chain reaction, and yields 4 molecules of HCl per quantum absorbed. Although the mechanism of the process has not been fully established, it undoubtedly involves reaction between $CHCl_3$ and Cl

atoms liberated on absorption of radiation; the atoms in the chain are probably regenerated by reaction of the free radicals with a chlorine molecule. The quantum yield is not altered by presence of hydrogen, but is increased by nitrogen. Oxygen raises the quantum yield very considerably, but in this case the mechanism is very probably different.
H. F. G.

2635. Photosynthesis in Tropical Sunlight. Parts III and IV. A. R. Rajvansi and N. R. Dhar. *J. Phys. Chem.* 36. *pp.* 567–585, *Feb.*, 1932.—These papers record a continuation of previous work [see Abstract 3630 (1931)]. Part III deals with the synthesis of formaldehyde, which has been obtained from carbon dioxide and water in the presence of the following sensitisers and sunlight: chromium oxide, cobalt carbonate, nickel carbonate, manganous chloride, copper carbonate and nickel sulphate, of which manganous chloride and cobalt carbonate appear to be the best. Some dyestuffs like methylene blue and malachite green are also good photosensitisers, although many fluorescent dyestuffs fail to bring about the synthesis of formaldehyde from carbon dioxide and water. Formaldehyde has also been obtained by exposing solutions of the alkali bicarbonates with several photosensitisers. With nascent carbon dioxide obtained by the interaction of carbonates and hydrochloric acid, no colour photosensitiser appears to be necessary for the formation of formaldehyde. In all these cases the yield of formaldehyde is about 50 to 30 times the sensitiveness of the colour test. In Part IV the polymerisation of formaldehyde to reducing sugars is described as being effected by light in the presence of ferric chloride, chlorophyll, nickel carbonate, methyl orange and zinc oxide, of which ferric chloride is the best. This paper also records the synthesis of certain complex nitrogenous compounds and a general discussion of the results obtained in both parts. H. H. Ho.

2636. Photosensitised Decomposition of Nitrogen Trichloride. Part II. Effects of Surface and Inert Gases and the Mechanism of Reaction. J. G. A. Griffiths and R. G. W. Norrish. *Roy. Soc., Proc.* 135. *pp.* 69–83, *Feb.* 1, 1932.—In continuation of previous work [see Abstract 2855 (1931)] it is shown that the photosensitised decomposition of nitrogen trichloride by chlorine is a homogeneous change propagated by a chain mechanism. In a matured vessel the quantum efficiency is primarily independent of the illuminated surface, and of the total surface. In a vessel which has been washed with water or heated to over 100° C., however, the quantum efficiency may be abnormally high, and the maturing of a vessel is associated with the formation of an invisible film of ammonium chloride on the glass surface, which indirectly establishes a constant condition of chain rupture in the gas phase. In the presence of inert gases the quantum efficiency is depressed to a limiting value in the neighbourhood of 2, according to the equation: $\gamma = 1/\Sigma \,.\, (k_x[X]) + 2\cdot5$, where $\Sigma(k_x[X])$ refers to the sum of the effects of the various gaseous species present. The action of the gases is explained as a process involving the stabilisation by ternary collision of an energy-rich complex (NCl_4) which is associated with chain rupture. H. H. Ho.

2637. Action of Light on Mixtures of Ozone and Chlorine. Part II. Results with High Ozone Concentrations. A. J. Allmand and J. W. T. Spinks. *Chem. Soc., J. pp.* 599–612, *Feb.*, 1932.—The results are given of the study of the photodecomposition of ozone, sensitised by chlorine, with reference to variation of concentration, wave-length, light intensity and temperature. It is concluded that with high ozone concentration and a low rate of absorption of light, a reaction chain is set up. The walls of the containing vessel are given an essential part in the mechanism proposed to account for the experimental data obtained. [For Part I see Abstract 4031 (1931).] J. K.

2638. Attempt to Activate Adsorbed Mercury Atoms by Ultra-Violet Light. L. H. Reyerson. *Physics*, 2. *pp.* 70–72, *Feb.*, 1932.—Mercury atoms which are adsorbed on the " active centres " of a copper catalyst are not activated by light from a mercury lamp sufficiently to cause a reaction to occur between ethylene and hydrogen. Mercury in the vapour state under the same conditions does cause reaction to take place. F. J. W.

2639. Photochemical Reaction of Carbon Monoxide with Ammonia and with Amines. H. J. Emeléus. *Faraday Soc., Trans.* 28. *pp.* 89–94, *Feb.*, 1932.—The experiments described support Berthelot's conclusion that formamide is yielded as a primary product which then undergoes secondary reactions. Less than 5 % of the ammonia reacting yields the normal decomposition products, nitrogen and hydrogen. The rate of ammonia decomposition is approximately doubled in presence of carbon monoxide. Of the possible mechanisms for the reaction which are discussed, it is concluded that the direct reaction $NH_3 + CO = HCONH_2$ is more probable than one involving the dissociation products. H. H. Ho.

2640. Radiation Hypothesis of Chemical Reactions and the Concept of Threshold Wave-Length. G. G. Rao and N. R. Dhar. *J. Phys. Chem.* 36. *pp.* 646–651, *Feb.*, 1932.—The radiation hypothesis as originally put forward by Lewis and Perrin being untenable, a modified viewpoint is submitted according to which the wave-length calculated from the temperature coefficient of the dark reaction, represents the threshhold limit. Wave-lengths longer than this will have no action, whereas wave-lengths shorter than this limiting value will accelerate the reaction, provided they are absorbed. A second method of obtaining this threshold wave-length is described which is in close agreement with the above. It is found that the quantum yield in any reaction generally decreases with increasing wave-length. H. H. Ho.

2641. Effect of Ultrasonic Radiation on Indicators. S. C. Liu and H. Wu. *Am. Chem. Soc., J.* 54. *pp.* 791–793, *Feb.*, 1932.—Twelve unbuffered indicator solutions, saturated with air or oxygen, showed colour fading when exposed to ultrasonic radiation. Buffered solutions gave the same result. The colour of gas-free solutions and solutions saturated with hydrogen did not fade when exposed. These observations show that indicator molecules are permanently destroyed by oxidation under the influence of ultrasonic radiation. H. H. Ho.

2642. Hydrogen Effect. F. Tödt. *Zeits. f. Elektrochem.* 38. *pp.* 12–13, *Jan.*, 1932.—The buffer solution containing a neutral salt is found to become acid when in contact with the hydrogen electrode. The significance of this so-called " hydrogen effect " was discussed by Wolf [see Abstract 652 (1932)] and in the present article the effect of the liberation of acid on the determination of pH, and the magnitude of the acidity produced are considered. F. J. B.

2643. Influence of Electrolytes on Photovoltaic Phenomena. R. Audubert. *Comptes Rendus,* 194. *pp.* 82–84, *Jan.* 4, 1932.—It is probable that in many cases contact of a photosensitive electrode with a solution of an electrolyte causes an irreversible change at the electrode. Measurements have been made with electrodes of cuprous iodide, cuprous oxide, silver sulphide, silver iodide and mercurous iodide in contact with solutions of potassium sulphate buffered with citric acid and disodium hydrogen phosphate to a range of values of pH between 9 and 2·8. Decrease of the pH of the solution causes an increase of the potential of a positive photoelectrode and a decrease of that of a negative electrode. The chemical composition of the solution is also of importance. Measurements with solutions of acids and alkalis and salts of different metals indicate that the potential of an electrode which has a positive photopotential in potassium sulphate solution will have a larger positive potential in a reducing solution and a smaller or even reversed potential in an oxidising solution; correspondingly, the potential of a negative photoelectrode will be greater in an oxidising solution and smaller or of reversed sign in a reducing solution. In certain cases a specific influence is exerted by salts of a metal of which a compound is contained in the electrode, and in all such cases the photoeffect diminishes in absolute value as the kation concentration is increased. This fact eliminates the possibility of the influence of electrolytes being due to a photoelectric effect at the electrode-solution interface, and a purely electronic explanation is also inadmissible, since, contrary to the experimental results, it would require the emission of electrons by a positive photoelectrode to be large in an oxidising solution. It is suggested that the water present undergoes photolysis and that the oxygen and/or hydrogen liberated displaces the equilibrium at the electrode, which acts merely as an acceptor. H. F. G.

2644. Activities and the Standard State. Part I. Activity Coefficients. Part II. Electrode Potentials. A. Macfarlane and O. Gatty. *Phil. Mag.* 13. *pp.* 283–296, *Feb.,* 1932.—The relationships between the standard states and activity coefficients of a solute in solution were investigated for a number of concentration scales. It is shown that the physical interpretation of the activity coefficient is simplified by expressing the concentration in gramme-molecules in a fixed quantity of solvent. The concentration of the solute in the standard state is, in general, a function of the temperature and pressure of the solution. A knowledge of the electrode potentials of the anions in different solvents is shown to enable the molal free energies of transfer of electrolytes in infinitely dilute solutions to be calculated, and compared with results derived from the Born equation. The use of volume normality as unit of concentration is advocated. F. J. B.

2645. Standard Electrode Potentials in Ethyl Alcohol. A. Macfarlane and H. Hartley. *Phil. Mag.* 13. *pp.* 425–443, *Feb.,* 1932. *Supplement.*—The following values (volts) are found for standard electrode potentials in ethyl alcohol at 25°: Li, — 3·042; Na, — 2·657; Tl, — 0·343; Ag, 0·749; Cl, 1·060; Br, 0·789; I, 0·317. Measurement of the solubility products of various sparingly soluble salts in ethyl alcohol gave the values: AgCl, $1\cdot2 \times 10^{-14}$; AgBr, $1\cdot0 \times 10^{-16}$; AgI, $1\cdot4 \times 10^{-19}$; AgCNS, $4\cdot7 \times 10^{-15}$; TlCl, $1\cdot3 \times 10^{-5}$. The solubility products of the silver halides are about a thousandfold less in methyl alcohol than in water, and there is a further decrease to about one-fifth in passing from methyl to ethyl alcohol. These results are used to calculate the partial molal free energies of transfer of a number of electrolytes, the values thus obtained being compared with those derived from the Born equation. The dissociation constant of ethyl alcohol is found to be $1 \cdot 9 \times 10^{-19}$. Discussion of these results leads to the conclusion that the electrical contribution of the Born equation is not the only factor in determining the free energy of solvation, and supports the view that the ion is associated, to an extent dependent on its size and on the dielectric constant of the medium, with molecules of the solvent in which it is dissolved. T. H. P.

2646. Glass Electrode Studies: Cupric Hydroxy-Acid Complexes. C. Morton. *Faraday Soc., Trans.* 28. *pp.* 84–88, *Feb.*, 1932.—Electrometric measurements by means of the glass and copper electrodes indicate that, in neutralised solutions of cupric tartrate, citrate, malate and salicylate, the basic complexes $Cu_8(OH)_{10}(C_4H_4O_6)_3$, $Cu_3(OH)_3C_6H_5O_7$, $Cu_2(OH)_2C_4H_4O_5$ and $Cu(OH)(C_6H_4OH . COO)$ respectively are present. In alkaline solution the complexes are decomposed with formation of highly basic hydrosols. There is no electrometric evidence of the formation of stable cupric complexes with glyceric, lactic, glycollic or mandelic acid, and the apparent stability of the cupric salts of these hydroxy-acids in the presence of caustic alkalis is due to the peptising properties of the hydroxy-acid anion. T. H. P.

2647. Electrostatic Potential at the Boundary Phase between Electrolyte and Inactive Electrodes and the Physical Chemistry of the Flotation Process. B. Kamienski. *Zeits. f. phys. Chem.* 158. *Abt.A.* 5–6. *pp.* 441–443, *Feb.*, 1932.—It is shown from the literature that the wetting process of light floating arcs (inactive electrodes) can be considered as a case of electrical potential at the boundary phase. It is shown by preliminary experiments of the electrostatic potential at the boundary phases of graphite/electrolyte, platinum/electrolyte and galena/electrolyte, the wetting processes of the electrodes being shown with aqueous terpineol–potassium xanthogenate emulsions, that we have here actually an important case of the setting up of a potential in contrast to easily attackable electrodes where the potential is very low. [See also Abstract 1728 (1929).] J. K.

2648. Oxidation Potentials of Ferric and Ferrous Chlorides. S. R. Carter and T. J. Glover. *J. Phys. Chem.* 36. *pp.* 679–687, *Feb.*, 1932.—The potentials of cells in which the oxidation half-element consists of mixtures of ferrous and ferric chlorides in hydrochloric acid of varying concentration from $0 \cdot 1\,N$ to $10 \cdot 02\,N$ were measured at 20° and 60° C. The normal calomel electrode was employed as the comparison electrode. It is shown that the relationship between the e.m.f. of the oxidation cell and the ratio of ferric to ferrous iron follows a logarithmic law. The heat of the cell reaction was calculated for the various concentrations of hydrochloric acid. F. J. B.

2649. Concentration Cell with Ternary Electrolyte. K. Masaki. *Chem. Soc. Japan, Bull.* 7. *pp.* 35–44, *Feb.*, 1932. *In English.*—The e.m.f.s of concentration cells with ternary electrolytes were studied by three methods: (1) at the anion reversible cell with mercury electrode, (2) at the anion reversible cell with silver electrode, (3) at the kation reversible cell with amalgam electrode. The electrolytes used were chlorides of zinc, strontium, barium, calcium and magnesium. Equations are developed from theoretical considerations to calculate the e.m.f. of the cells investigated. Mobilities at 30° C. and activity coefficients are calculated for zinc, barium, strontium, calcium, magnesium and chlorine ions. F. J. B.

2650. Application of Debye's Electrolytic Theory to Concentrated Solutions. G. Scatchard. *Phys. Zeits.* 33. *pp.* 22–32, *Jan.* 1, 1932.—Hückel's extension of the Debye-Hückel theory, taking into account the action of electrolytes on the dielectric constants, has proved useful by providing an interpolation formula for the chemical potentials or activity coefficients, but the values it furnishes for the apparent magnitudes of the ions and of their action on the dielectric constants are questionable. By further extension of the theory so as to include the effects of non-ionic forces, equations are deduced which explain, at least approximately, the nature of the alteration of the osmotic and activity coefficients, such as those observed by Fajans and Karagunis. These equations are too complicated to be applied to practical interpolations, for which purpose Hückel's approximation suffices, but they probably explain with sufficient accuracy the mutual actions between ions and molecules in an electrolyte solution, excepting the quantum energies which lead to actual chemical compounds. T. H. P.

2651. "Relaxation" Term in Debye and Hückel's Theory of Ionic Mobility. H. H. Paine. *Cambridge Phil. Soc., Proc.* 28. *pp.* 83–92, *Jan.*, 1932.—A new method is suggested for deducing the "relaxation" term in the Debye and Hückel theory of ionic mobility and it is pointed out that the principle of a "relaxation force" for the ionic atmosphere around a charged particle, for example a colloid particle, necessitates an addition to the expression usually employed for the cataphoresis of colloid particles. The ions in an ionic atmosphere which carry a charge opposite in sign to that on the central particle are attracted to the central particle. However, when an electric field is applied to the liquid, they are able to drift away in virtue of their molecular energy, and the migration of the central particle is dependent on this fact. The relaxation force is the resultant of the forces between central particle and ions during this separation. Such a force draws the ions in the atmosphere after the central particle to some extent. From a consideration of the energy involved in the separation of particle and atmosphere, and of the molecular energies of the ions, it is possible to calculate the number of ions which this relaxation force could draw through the liquid as though they were bound to the particle, and hence to deduce the magnitude of the force in terms of the friction constant of the ions. The expression is the same as that given by Debye and Hückel. The cataphoresis equation usually employed for colloidal particles takes no account of this relaxation force during migration; the corrected equation is given. T. H. P.

2652. Electrolytic Conduction in Amalgams and Other Alloys. C. Wagner. *Zeits. f. phys. Chem.* 15. *Abt.B.* 4–5. *pp.* 347–352, *Jan.*, 1932.—An approximation formula is derived relating the electrolytic transference number with the diffusion coefficient in dilute binary alloys. The equation yields numerical values which are of the same order as those obtained directly by experiment, in confirmation of the primary assumption that the movements of the metal ions and electrons are independent of one another, and of the view that extensive ionisation takes place. H. F. G.